The Electrical Industry's Weekly Magazine

June 16, 1958

Electrical World

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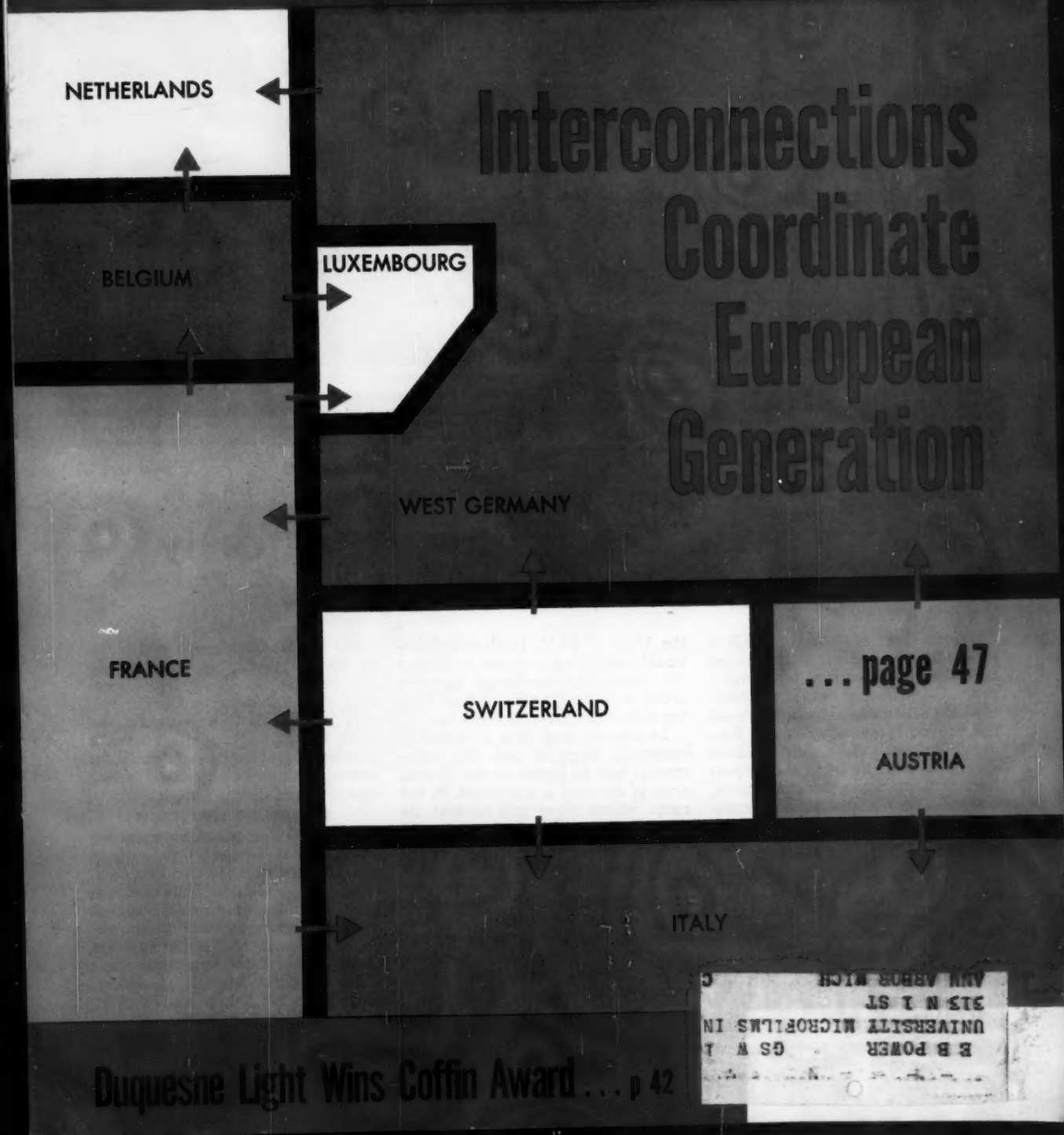

Interconnections Coordinate European Generation

. . . page 47

Duquesne Light Wins Coffin Award . . . p 42

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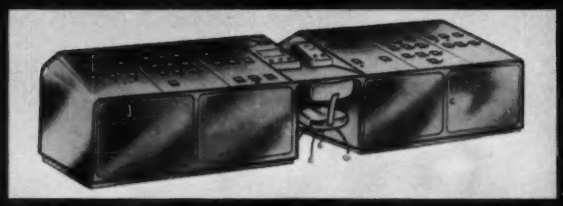
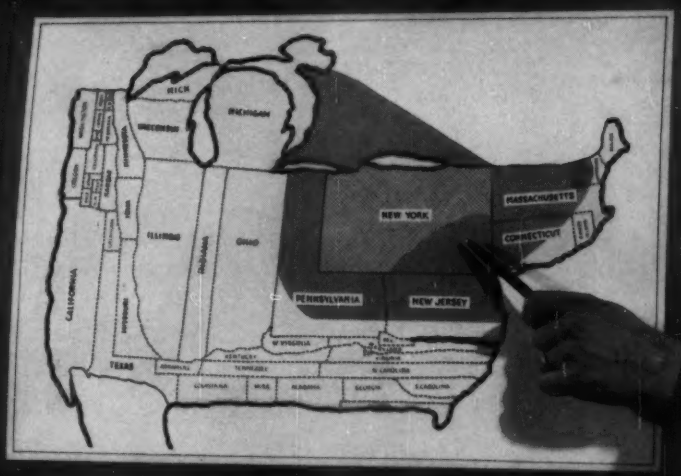




Map comparing state size by industrial output produced by Russell T. Gray, Inc., Chicago.

Scope of new computer (preliminary artist's conception shown in inset) is dramatized on this map. Size of the states is based on their industrial productivity. Computer will determine the most efficient over-all generating schedule for Niagara Mohawk Power Corporation and New York State Electric and Gas Corporation and will provide power billing cost data for companies (shaded area) interconnected with these Upstate New York utilities. Pioneering studies on the basic theory for economic dispatching among systems with multiple interconnection were made by Dr. L. K. Kirchmayer, Manager of General Electric System Generation Analytical Engineering and his associates.

New General Electric dispatch computer promises

Improved Operating Economy for Upstate N.Y. Utilities

Understanding of how to achieve economic dispatch for a single system has been known for several years. Co-ordinated economic operation of two or more areas, however, has proved more complicated. Economic dispatch data must include several factors: thermodynamic performance of the generating units, fuel cost at the plants, and incremental transmission losses.

INTERCONNECTION PROBLEM SOLVED

Studies made by General Electric's Analytical Engineers have made possible the computer now being built by G.E.'s Computer Department for two Upstate N.Y. utilities (Niagara Mohawk Power Corporation and New York State Electric and Gas Corporation). This device is based upon the use of individual dispatching computers which represent each of the four areas within the Upstate N.Y. territory. Additional computing sections determine the economic interchange between areas, and the division of flow over the individual interconnections.

In essence, each area is placed in economic dispatch and the incremental cost of power at the boundaries of the area is computed. In the cases where there are several tie points the computer will weight the costs according to incremental power flow over each interconnecting line, as well as account for wheeling losses. The incremental costs at the boundaries are then compared and the interchanges are adjusted to cause these Upstate N.Y. utilities to operate in complete economic dispatch.

The computer makes use of solid state circuitry which results in high reliability, minimizes cooling equipment and space. Plug-in modules allow for easy expansion and maintenance. For ease in reading, the output is presented in digital form on a digital voltmeter. Output will also be recorded in printed form. With the use of an attachment, a punched tape may be obtained for subsequent use in automatic billing computation.

ENGINEERING LEADERSHIP

Take advantage of G.E.'s pioneering leadership in advanced theory and manufacture. Get further information on how General Electric can provide computing and control equipment for economic dispatch—on single, or interconnected systems. Contact your local Apparatus Sales Office. General Electric Company, Section 301-382, Schenectady 5, N.Y.

MORE POWER TO AMERICA

GENERAL ELECTRIC

Electrical World

Vol. 149, No. 24 JUNE 16, 1958

Published for 84 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

In This Week's Issue

p 42

p 45

CURRENT EVENTS

Duquesne Light Wins Coffin Award

GE presents 1957 prize for participation in design and construction and its operation of Shippingport, Pa., atomic power plant ..... p 42

MANAGEMENT

High Return, Low Bills Go Together

"Fair Value" companies not only earn higher return rates, but residential customers pay less per kwhr..... p 71

MEETING

Cites 'Most Promising' Reactor

SEE speaker tells advantages of heavy-water power reactor; Phase-angle meter advocated for use on Hv line....p 55

SYSTEM ENGINEERING

CVPE Selects and Trains Operators

R. N. Youtz, Connecticut Valley Power Exchange

Screens through aptitude tests: puts applicants through classroom and on-job courses..... p 45

TRANSMISSION

Promotes Europe's Power Pool

UCPTE fosters agreements for mutual exchanges of needed power across the frontiers of eight Western countries.....p 47

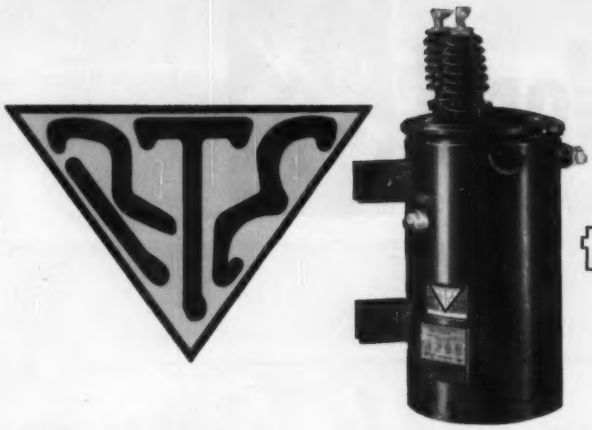
Remote Stations Can Be Economic

R. D. Dartnall, H. C. Simmons Jr, General Electric Co

Higher transmission voltages justify new generation at mine mouth up to 275 miles from load area..... p. 52

Departments

Editorials 39
• Electrical Week 19
Engineering Reference Sheet 58
Executive Reader 22
From the Publisher..... 5
How To 50
• Management Newsletter .. 71
Manufacturers News 64
New Equipment 79
News About People..... 88
Readers Forum 94
Selling 84
INDEX TO ADVERTISERS... 94



transformers

EASY TO INSTALL

Light, compact design makes handling easy.

- **Standard EEI-NEMA mounting brackets.** Upper bracket on tank has jump proof lug.
- **Both high and low voltage bushing terminals will accommodate either copper or aluminum conductor** in full range of sizes required by NEMA Standards.
- **Ground connector can be rotated** to provide three possible ground wire entrances.
- **Locked type secondary bushings** provide safe, speedy hookups.

EASY TO MAINTAIN

R T & E's new transformers are loaded with features to minimize maintenance.

- **Externally operated tap changer** eliminates entering tank; handle is marked for easy identification of tap position. Taps can be changed readily without disturbing transformer seals.
- **Terminal failures due to stress corrosion are minimized** by use of special aluminum bronze alloy terminals.
- **Band type cover clamp** and tank cover can be removed as a single unit.
- **Completely "Weather Protected" to resist corrosion** by three coats of baked on modified alkyd paint, arc welded seams, stainless steel band type cover clamp.
- **Inhibited Oil—(D.B.P.C.) effectively increases transformer life** up to 15 times by reducing sludging.
- **Locked type secondary bushings** will not turn when line leads are attached thus maintaining tight gasket seal.

equipment to help provide power for America RT&E CORPORATION

PORTLAND, OREGON • WAUKESHA, WISCONSIN

Frank Wilkes Will Be Remembered

With the death of Frank M. Wilkes, Southwestern Gas & Electric Co's chairman, the utility industry has lost a real champion.

"Cap", as his friends liked to call him, never walked away from a fight. To be sure, he didn't win them all—no one does. But when the dust settled, his opponents always knew they'd been in a scrap, they knew exactly where "Cap" stood on the issues, and more often than not they were left with a towering respect and admiration for the man and the issues for which he stood.

The utility industry can count itself fortunate that many of Cap's battles have been its own. That's how he earned his reputation as "one of the strongest advocates of the private enterprise system in the U.S."

It's to "Cap's" eternal credit that he was a fighter for the industry when there weren't many and when the industry needed them most. He was out front when lesser men hung back from the rough and tumble of public debate on power issues before Congressional groups and elsewhere.

It's a fitting end for such a Champion as "Cap" that he should die with his boots on facing a Congressional Committee in defense of his own and his industry's interests.

Fischer Black

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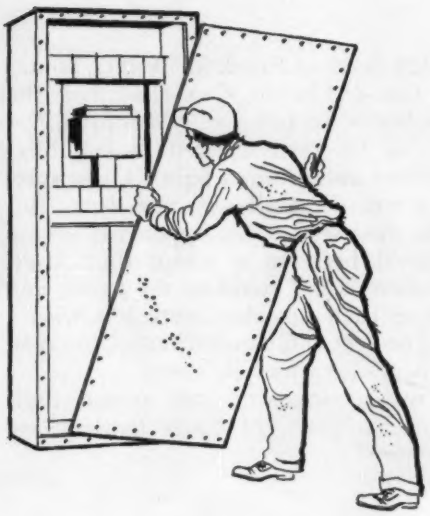
METAL-CLAD SWITCHGEAR



HOW MUCH DO YOU NEED A HINGED REAR DOOR?

Some switchgear makers say you don't need it at all. They say you should struggle with a 75-lb. sheet metal cover and grope for the screw holes. That's good enough for you, they say.

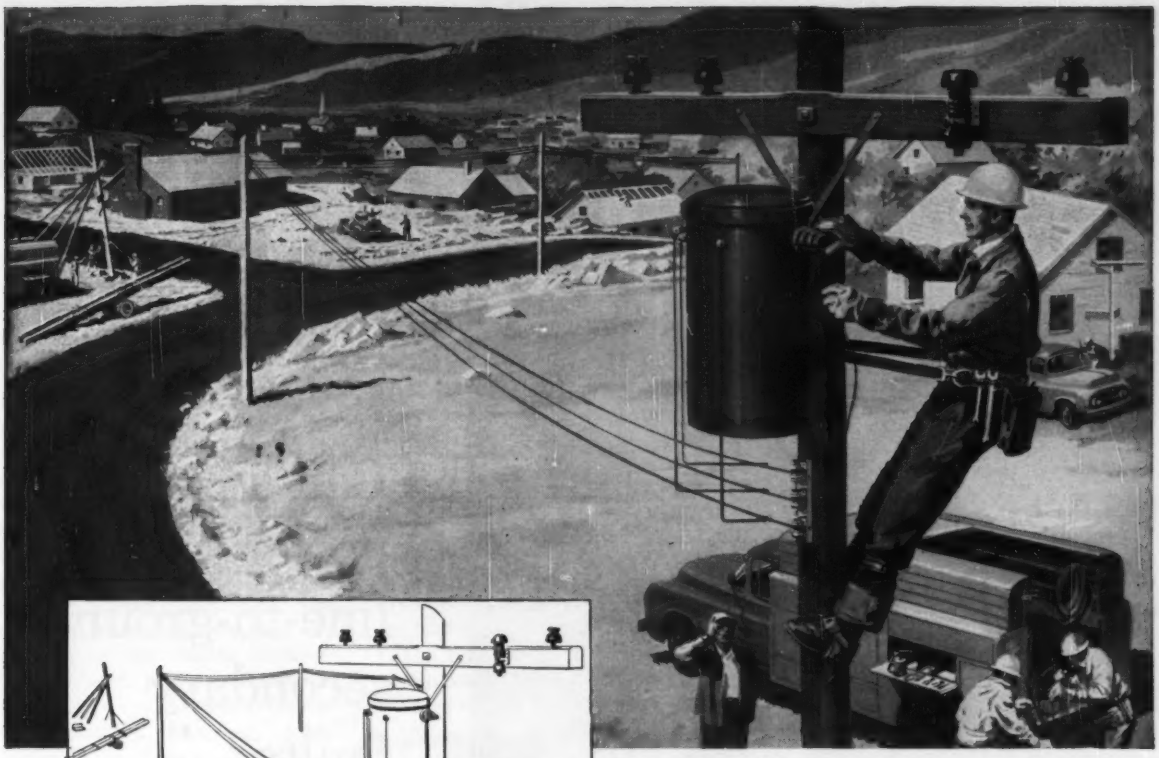
But I-T-E gives you hinged rear doors as standard equipment on metal-clad switchgear—at no extra cost. And many other features besides. More solid construction throughout . . . means longer life. Sturdier enclosures to simplify installation. Finer finishes to give your whole switchboard a richer look. Examine an I-T-E switchgear installation. It is just plain better built. But you pay no more.

How much do you need I-T-E's double blowout coils —standard on 15 kv circuit breakers? Under all fault currents, here is extra protection, plus assurance of longer circuit breaker life that no other switchgear offers you. Yet I-T-E charges you no more.

Recently I-T-E developed FLAMETRAP insulation that snuffs out flame in seconds and leaves no toxic fumes. It is today's most advanced flame retardant insulation—now yours on I-T-E switchgear for no extra cost.

This briefly is I-T-E's policy: to make its switchgear better, in construction, performance and appearance—but to charge no more. Why not make sure that you get all the value your switchgear dollars can buy. Get I-T-E switchgear. For a complete outline of our extra-quality features, write Switchgear Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E CIRCUIT BREAKER COMPANY
PHILADELPHIA, PENNSYLVANIA



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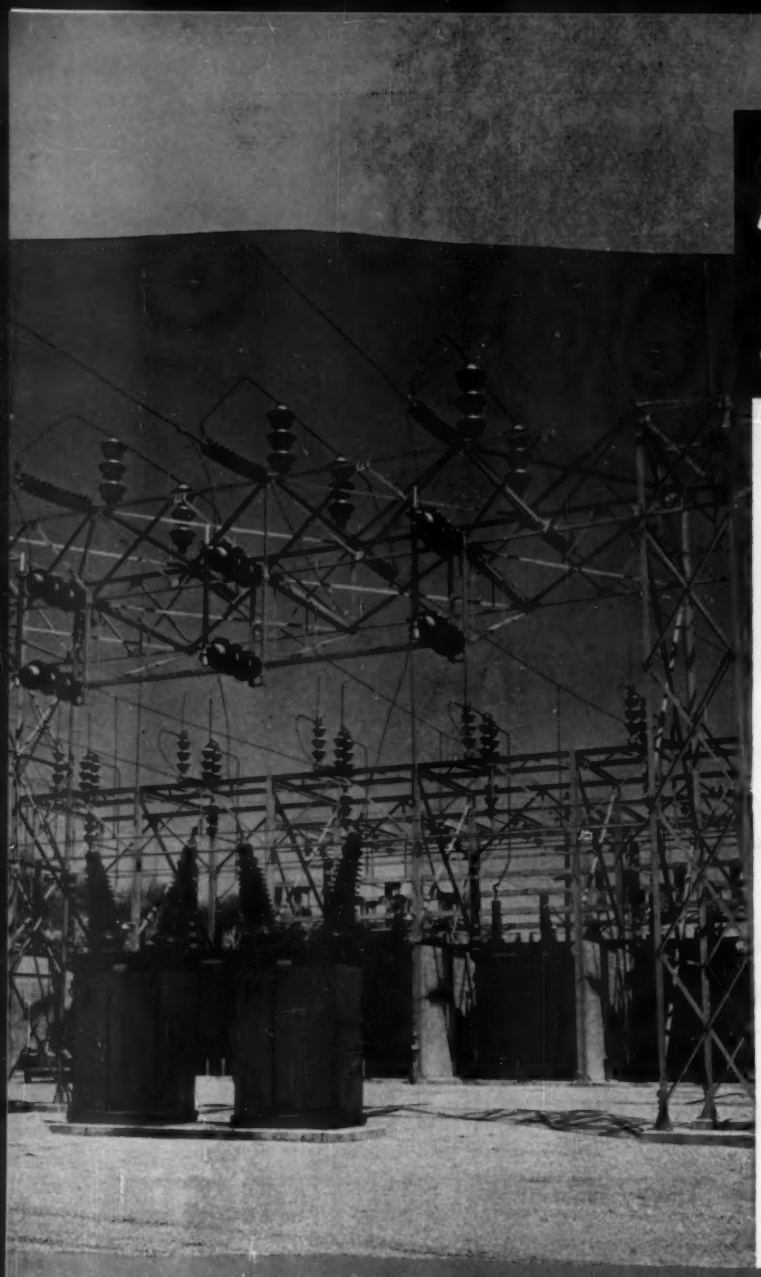
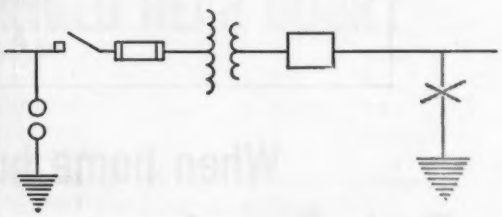


Can a primary power fuse "see" line-to-ground secondary faults?...



(Although the data illustrated are for self-cooled transformers, similar tables are available for forced-air-cooled transformers.)

POWER TRANSFORMERS

***TABLE 3 Minimum Ampere Ratings for the Primary Fusing of Three-Phase or Banks of Three Single-Phase Self-Cooled or Water-Cooled Power Transformers**

Nominal System Kv →	23		27.6		34.5		46		69		115		138	
Transformer 3-Phase Kva ↓	Full Load Current (Amps)	Fuse Unit Rating (Amps)	Full Load Current (Amps)	Fuse Unit Rating (Amps)	Full Load Current (Amps)	Fuse Unit Rating (Amps)	Full Load Current (Amps)	Fuse Unit Rating (Amps)	Full Load Current (Amps)	Fuse Unit Rating (Amps)	Full Load Current (Amps)	Fuse Unit Rating (Amps)	Full Load Current (Amps)	Fuse Unit Rating (Amps)
1000	25.1	40E	21	30E	16.7	25E								
1500	37.7	50E	31.4	50E	25.1	40E	18.9	25E	12.5	20E	7.6	10E	6.3	10E
2000	50.3	65E	41.8	65E	33.5	50E	25	40E	16.8	25E	10	13E	8.4	13E
2500	62.8	100E	52.5	80E	42	65E	31.5	50E	21	30E	12.5	20E	10.5	15E
3750	94.3	125E	78.5	125E	63	100E	47	65E	31.5	50E	19	25E	15.7	25E
5000	126	175E	105	150E	84	125E	63	100E	42	65E	25	40E	21	30E
7500	188	250E	157	250E	126	175E	94	125E	63	100E	37.5	50E	31.4	50E
10 000	252	400*	210	300E	167	250E	126	175E	84	125E	50	65E	42	65E
15 000	376	600*	314	500*	252	400*	189	250E	125	175E	76	100E	63	100E

*Use two fuse units in parallel, each having an ampere rating half of the listed ratings.

Here's an up-to-date answer:

The answer is a qualified "yes" and depends on selection of the proper fuse in the proper ampere rating and speed.

Let's examine fuse selection. Until now, for want of a better approach, the protection engineer has had to use fusing ratios or ampere rating recommendations which were arbitrarily high. Allowances had to be made for not only short-time daily overloads *(both with, and without, forced-air cooling)*, switching, and energizing transients but also for damaging of the fusible element. Moreover, extra provision had to be blindly made for short-time emergency overloading. In this way he was assured that the fuse would not blow unnecessarily. But unfortunately, the full protective range of the modern power fuse was lost.

To help the protection engineer avoid such overfusing, S&C has developed tables of Minimum Ampere Rating Recommendations* for its SMD Power Fuse (see one of four such tables below, left), each one of which is a "sharp-pencil" recommendation that provides real protection for the transformer against secondary faults, even line-to-ground.

The key to these recommendations lies in the precise significance of the term "minimum" in contrast with the customary "cover-all" use of the word. These recommendations have been pared down by tailoring them to include provisions only for transients and short-time daily overloads of the magnitudes set forth by ASA.

These minimum ampere rating recommendations expressly *exclude* allowances for short-time emergency overload, and margins for fuse damage. Here are the reasons:

1. The margin for fuse damage is obviously unnecessary with S&C silver fusible elements.
2. The short-time emergency overloading of fuses is a nonrecurring, controllable condition — such as would occur when one transformer in a duplex substation setup is temporarily out of service (thus placing all the load on the other transformer).

To enable the protection engineer to determine what degree of short-time emergency overload an SMD fuse can sustain, S&C has developed a family of "Short-Time Emergency Overload Capability Curves." These curves plot overload time in hours against overload current. The curves will show that in most applications the fuse ratings given in the Minimum Ampere Rating Recommendation tables will have adequate short-time emergency overload capability, even though allowances were not made for such overloads in the Recommendation tables. By using this special information—new to power fuses—the protection engineer can avoid revising his ampere rating selection upwards to take care of a short-time emergency overload condition that might occur only once a year. Therefore, he does not have to give up some transformer protection.

This paring down of ampere rating recommendations is done to enable the fuse to "see" faults of a much lower order than would otherwise have been possible. A fuse naturally won't pick off the lowest line-to-ground faults, but transformer protection will be greatly increased.

Write for Data Bulletin 262, "Selecting SMD Fuse Units," to S&C ELECTRIC COMPANY, 4421 Ravenswood Ave., Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.

The ampere ratings listed in the table (left) will carry continuous loads within the nameplate rating of the transformer, or short-time daily overloads as set forth below.

Daily Overloads to Give Normal Life Expectancy

(Abstract from ASA Publication, "Guide for Loading Oil-Immersed Distribution Transformers and Power Transformers," Appendix C57.92, published January, 1956.)

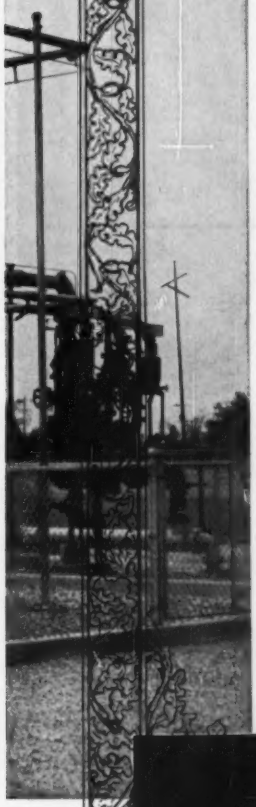
Time (Hours) ↓	Times Rated Kilovolt Amperes		
	Self-Cooled and Water-Cooled Transformers		
Initial Load* (Percent) →	90	70	50
½	1.59	1.77	1.89
1	1.40	1.54	1.60
2	1.24	1.33	1.37
4	1.12	1.17	1.19
8	1.06	1.08	1.08

*Use either average load for two hours previous to load above rating or average load for 24 hours (less overload period), whichever is greater. Ambient temperature assumed is 30° C for air and 25° C for water.

S&C ELECTRIC COMPANY

MOLONEY ELECTRIC COMPANY

INSTALLS A MOLONEY 135,000 KVA STEAM-ELECTRIC GENERATING STATION



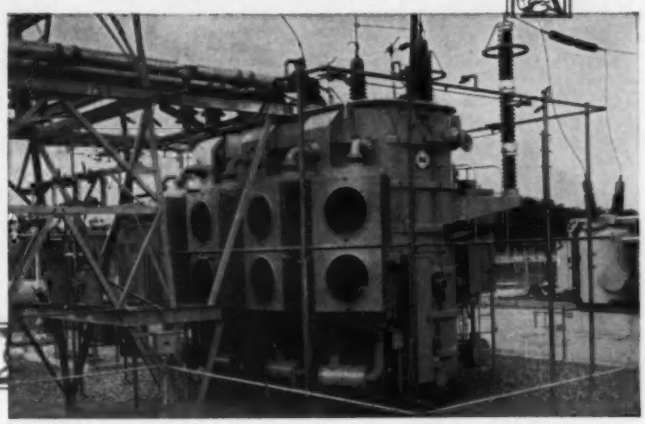
Another Example of Moloney's Abilities and Facilities Working with Utilities to Meet Specific Customer Requirements

The Michoud Station, now in operation, presented problems in the planning stage which required cooperation in the design and manufacture of component equipment. In the case of the transformer, one of the main components in this 13 million dollar plant, New Orleans Public Service Inc., required a 135,000 KVA, three-phase, sixty cycle, class FOA Transformer, H. V. 115,000 GRD. Y/66400 volts and L. V. 13,800 volts delta. It is the main station transformer connected directly to the generator. Customer's specific requirements had to be met in developing the design.

Michoud Station is an important link in the expanding facilities that New Orleans Public Service Inc., must provide to assure its customers of ample, dependable service and Moloney is proud to have furnished a major component of this installation.

MX58-12

Your nearest Moloney representative will be glad to explain in detail how Moloney can supply any size transformer you may require. Contact him today.



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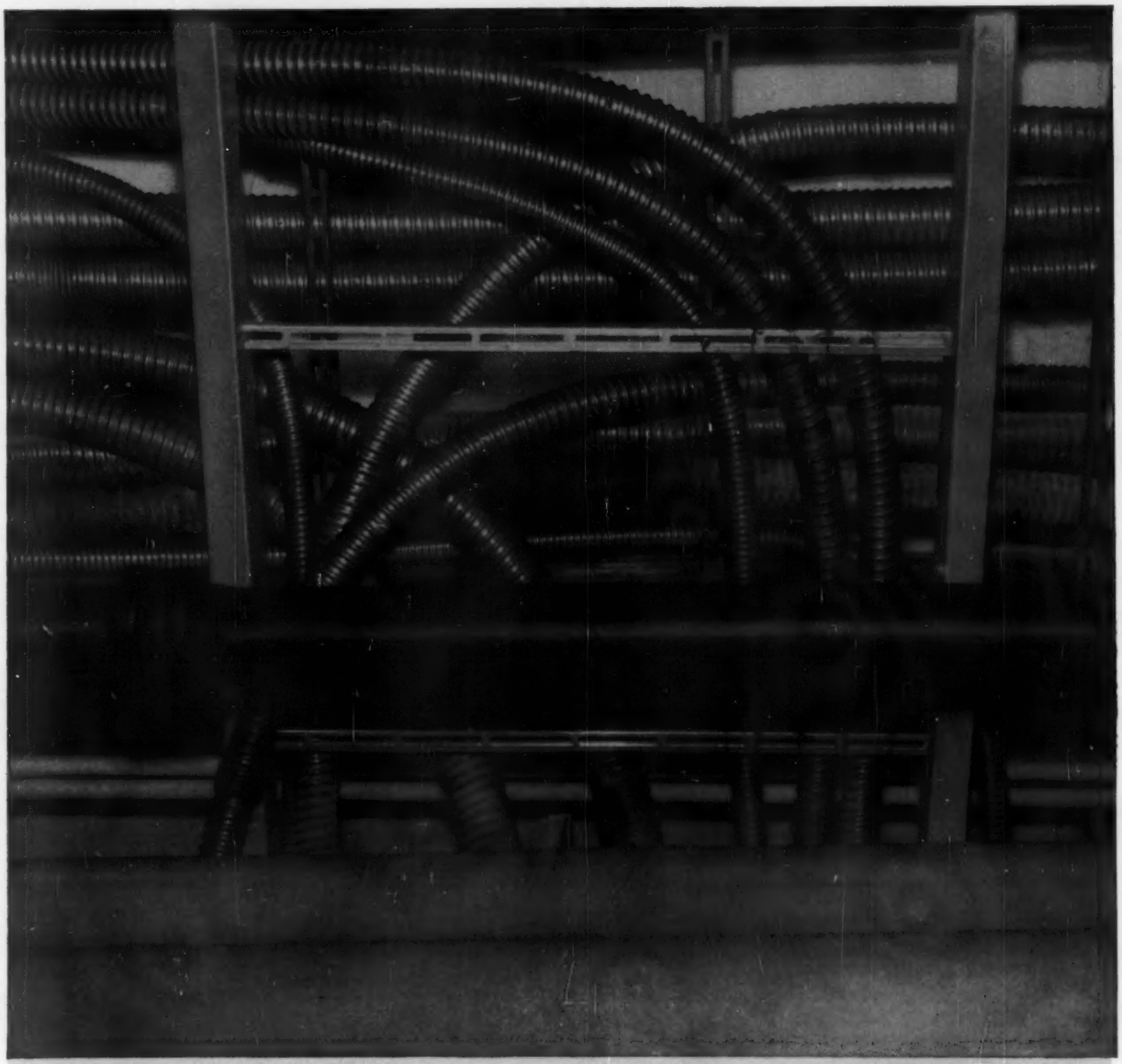

CREDITS—Owner: SCHLEGEL MANUFACTURING COMPANY, Rochester, New York; **Electrical Contractor:** T. H. GREEN ELECTRIC COMPANY, Rochester, New York; **Builder:** JOHN W. RYAN CONSTRUCTION, New York City; **Architect:** SERGE P. PETROFF, New York City; **Structural Engineer:** STROBEL AND SALZMAN, New York City; **Construction Engineer:** GUY B. PINERO, New York City.

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You could do this with conduit but think what it would cost!

JUST IMAGINE THE MAN-HOURS that would have been required to bend and contort steel conduit to fit this maze-like 480-volt, 3-phase, 4-wire industrial distribution system. We don't know how much more a conventional installation of cable-in-conduit would cost because Schlegel Manufacturing Company chose the sensible way out: flexible, easily installed USS Tiger Brand Armorlokt Interlocked Armored Cable.

Saves time—We know, from experience on other jobs, that a conduit system would have required about twice as much time to install. It would probably have required larger size cable, because of the higher voltage drop. It would have required about three times as much material.

Easily changed—Most important, though, this Armorlokt installation gives Schlegel Manufacturing Company a far more flexible and *revisable* installation. Machines can be moved and the electrical distribution system easily adapted to the changes when accessible, easily traceable Armorlokt is used.

Cuts cost—Past experience shows that a Tiger Brand Armorlokt installation on factory-made racks can cut installed cost as much as one half compared to conventional distribution systems. Also, it requires less space—often a major consideration in crowded factory areas. It can be installed inside or outside . . . is available in voltage ratings from 110 to 15,000 . . . with galvanized or stainless steel, aluminum, or bronze armor . . . with polyvinyl chloride jackets *over the armor* in especially corrosive applications.

USS, Tiger Brand and Armolokt are trademarks

Write for complete facts. Or call the nearest American Steel & Wire Sales Office. American Steel & Wire, General Offices: Cleveland 13, Ohio.

Step-down. Incoming voltage to Schlegel Manufacturing Company's main plant substation is 33,000 volts. This is stepped down to 480/277 volts, 3 phase, 4 wire, and distributed to unit substations like this one, where voltage is stepped down to 240 volts and distributed to plant electrical equipment. 600-volt Armorlokt was used throughout, in sizes #2 AWG, 2/0, 4/0, 350 MCM, and 500 MCM. Most of it was 3-conductor cable. Armor was galvanized steel. Schlegel manufactures beading fabric for doors on Ford and General Motors cars . . . also makes industrial fabric for other applications.

American Steel & Wire Division of USS **United States Steel**

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Example: Scale build-up in the main water supply line of a major Midwestern plant had reduced the "C" factor from 105 to 72. This situation became apparent just at the start of the peak season for the company. Management had a choice between laying an auxiliary line or trying to clean their present one. They decided to clean the line—but not the old-fashioned mechanical way. Time would not permit. Dowell was called in to do the job—chemically.

Dowell Service was fast—the job was done in three days. Dowell Service was effective—the "C" factor was increased to 92. Dowell Service was profitable for the customer—$71,000 was saved and the company's annual profit was protected.

With Dowell Service you receive the benefits of more than fifteen years experience in chemical cleaning—plus a full line of equipment, chemicals, and trained personnel. You pay one charge, get an efficient job, handled by experienced people.

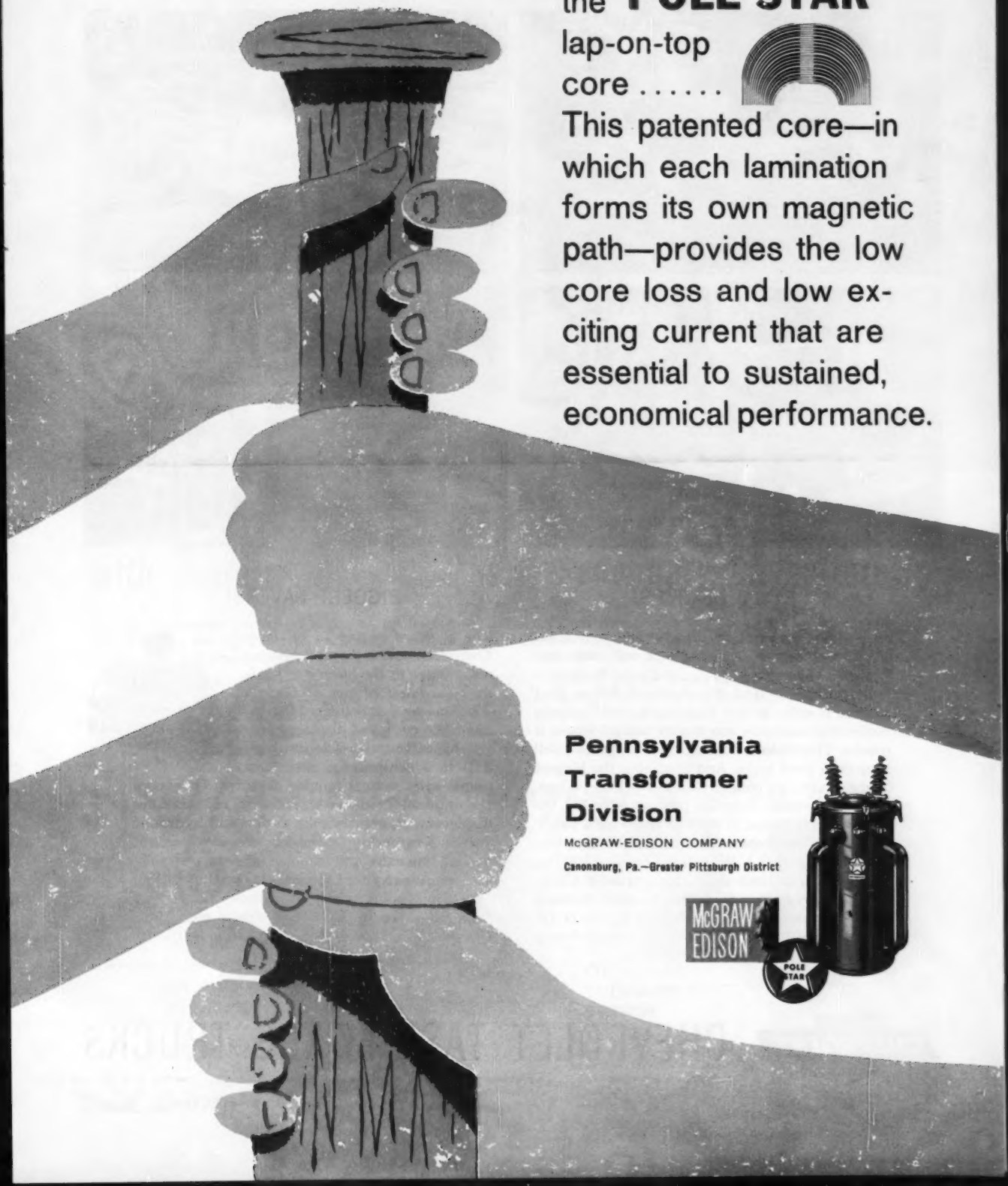
Your maintenance and operating engineers probably know about Dowell Service. Ask them for the facts. Decide for yourself about the additional profit possibilities to your company with Dowell Service working for you. DOWELL—A SERVICE DIVISION OF THE DOW CHEMICAL COMPANY. Headquarters and research center, Tulsa, Oklahoma, with 165 offices and stations to serve you.

Chemical cleaning service for industry DOWELL

When **"choosing up"** distribution transformers . . . .

consider the merits of the **POLE STAR** lap-on-top core . . . . .

This patented core—in which each lamination forms its own magnetic path—provides the low core loss and low exciting current that are essential to sustained, economical performance.

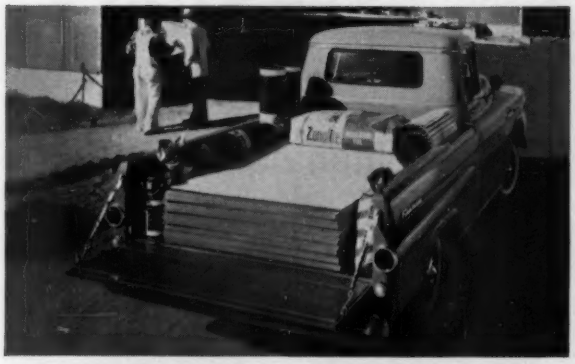


Pennsylvania Transformer Division

McGRAW-EDISON COMPANY

Canonsburg, Pa.—Greater Pittsburgh District

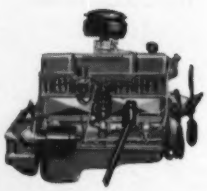
NEW CHEVROLET LOAD HUSTLERS— DESIGNED FOR STYLE AND SAVINGS!



STYLE LEADERS!

Here are trucks you'll be proud to put your name on! Chevy's high-style appearance will make you look good wherever you go . . . and your business is bound to benefit! And it's practical styling that pays off in extra utility. Handsome new Fleetside bodies, for example, are double-walled where it counts. They take a beating from cargo and still keep their good looks. And they offer the biggest loadspace of any comparable low-priced pickup. Thrifty Chevrolet Stepside pickups offer 78-, 98- and 108-inch bodies. If your job calls for a panel, you can choose from models with eight- and ten-foot bodies and G.V.W. ratings up to 7,400 lbs. Or, for door-to-door deliveries, consider Chevrolet's new Step-Van. This fast-working Forward Control truck comes complete with 8-, 10-, or 12-foot walk-in body. Chevy's got a handsome answer to *your* light-duty hauling needs!

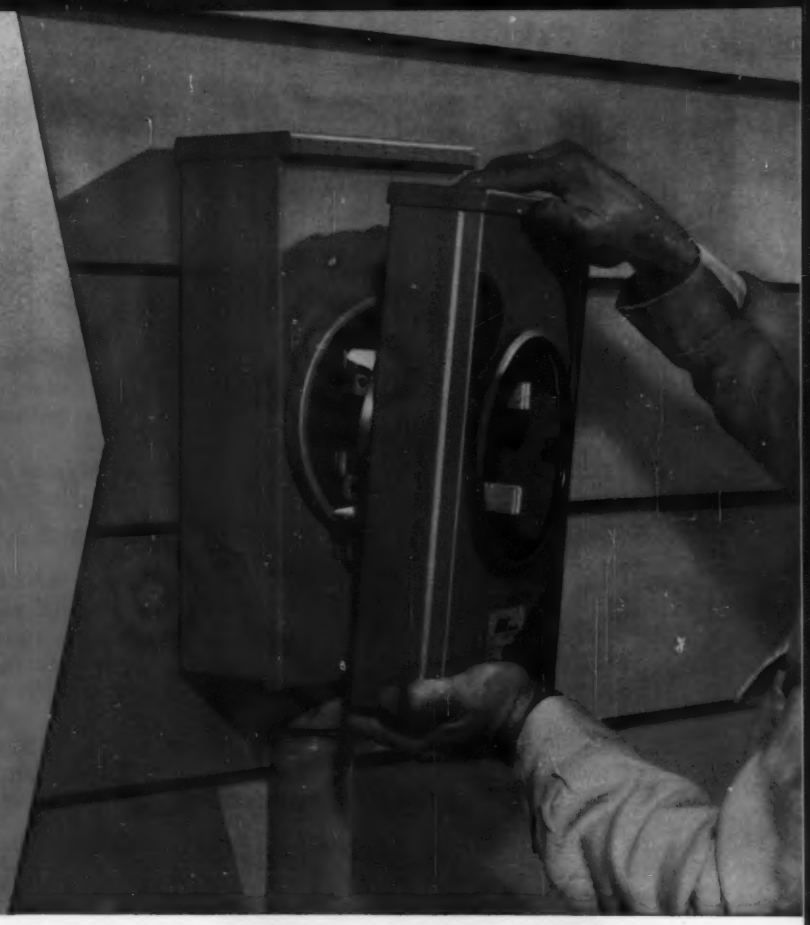
BIGGEST SAVERS!



The standard engine in all these Chevrolet trucks is the most popular dollar-saver in the history of hauling—the latest edition of Chevy's Thriftmaster 6. It delivers 145 h.p., has 235.5 cu. in. of displacement, reliable valve-in-head design, high 8.25 to 1 compression ratio and many more budget-minded features. Or choose the optional Trademaster V8 with 283 cu. in. of displacement, short-stroke design and hydraulic valve lifters for stay-on-the-job economy. Rugged, dependable axles and smooth, efficient transmissions help keep your Chevy saving on the job, too. Make it a point to get the whole Chevy story from your nearby Chevrolet dealer soon. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

CHEVROLET CHEVROLET TASK•FORCE TRUCKS

BEAT THE SUMMER HEAT STORMS!



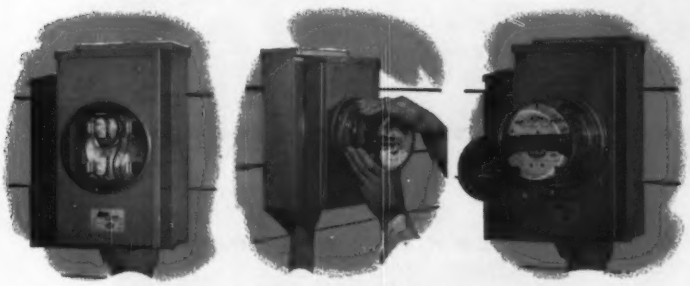
add low cost vars at point of greatest system benefit with SANGAMO SECOVAR Secondary Capacitors

The critical summer peak load is coming up fast! And with it comes the nightmare of overloaded distribution transformers and emergency changeouts.

You can avoid replacing overloaded equipment in most cases by permanently installing Sangamo Secovar Secondary Capacitors right at the meter box on your customer's premises. These 240 volt capacitors can be installed by one man—give maximum system benefits all down the line . . . from the service drop to the secondaries . . . to the distribution transformer . . . to the power transformer . . . to the generator.

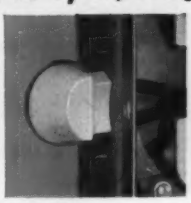
They provide a quick and easy solution to the problem of unloading hot distribution transformers. Secovar Capacitors are available in two types: Type S, a 2 kvar unit for socket mounting; and Type N, a 1 kvar unit for adjacent mounting. Bulletin 1131 gives full information.

SANGAMO ELECTRIC COMPANY, Springfield, Illinois



ONE MAN INSTALLATION

1. Plug Secovar unit into meter socket and install sealing ring.
2. Install watthour meter in Secovar socket.
3. Installation is complete—ready to supply vars to your system.



OPTIONAL THERMOSTATIC SWITCH

Automatically switches capacitor in and out on predetermined ambient temperatures. Standard range is on at 85° F.—off at 75° F.

PC58-4

UNIFORMITY

"VICTOR SUSPENSIONS—

NOT ONLY LOOK ALIKE—
THEY PERFORM ALIKE,"

says Robert L. Perry,
Factory Manager,
Victor Insulators Division,
I-T-E Circuit Breaker Co.

Why try to cut corners with suspensions whose mechanical and electrical characteristics may vary all over the lot? Be sure of uniformity with VICTOR Suspensions. They are made by the carload, year after year, yet each insulator is identical. Each has a built-in margin of safety that precludes failure on the line.

Big reason for this amazing uniformity is Purified Porcelain. This porcelain is denser, harder, stronger, has greater uniformity than any insulator porcelain ever made! Segregation and analysis of each shipment of raw material, scientific proportioning of ingredients, demineralization of all processing water and the use of densitizing pug mills make Purified Porcelain possible.

These processes together with quality-controlled manufacturing, and rigid, routine testing techniques make truly superior insulators. You just can't buy better suspensions—at any price!

I-T-E CIRCUIT BREAKER COMPANY
VICTOR INSULATORS DIVISION
Victor, New York

The Electrical Week

FUTURE NEWS ▶ **A Self Regulating Transformer is anticipated as the "SRT"** that Line Material Industries will announce June 23, according to unconfirmed but mounting reports from the field.

EEI HIGHLIGHTS ▶ **New EEI president is J. E. Corette,** Montana Power's president. Allen King, Northern States Power prexy, succeeds Corette as VP.

Maine Public Service and Florida P&L become EEI members.

National sales program aimed at increasing home use of electricity is okayed by EEI board. "In leading this new industry activity, EEI will sponsor and administer a basic, or core program," said outgoing Pres J. W. McAfee. Manufacturers and trade allies probably will integrate national advertising with this program.

LATE NEWS ▶ **Electric utilities are only major U. S. industry planning increase** in capital investment over last year, says SEC. Hike of 5% over 1957 is seen. Gas firms will decline 7%; business as a whole, 17%.

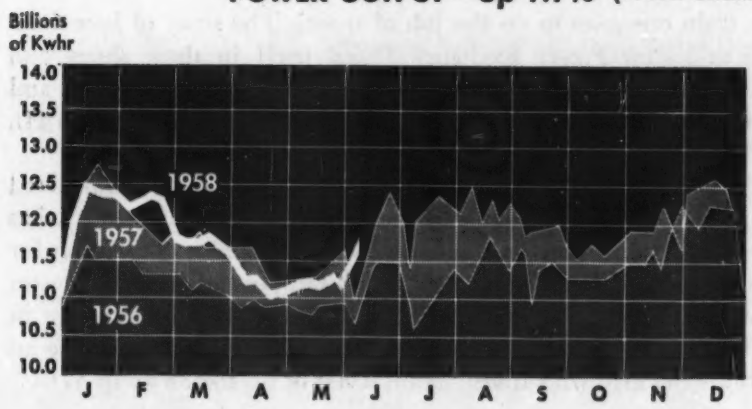
Democrats draft plan to spend $1 billion for A-power plants within five to seven years. Plan, arising from Joint Committee on Atomic Energy, would increase federal role in building advanced plants.

Federal government will build a 40,000 kw (e) gas cooled reactor unless solid industry interest is forthcoming quickly, warns AEC.

Fission power research by General Atomics Div, General Dynamics, gets $500,000 boost from new group of eight utilities in the West. GA's multi-million program is stressing gas-cooled reactors.

Britain completes England-Wales grid system, reportedly world's largest, by opening last of seven new control centers. Aim of the 8-yr, $7-million project: greater standardization and automatic control in Central Electricity Generating Board's system.

POWER OUTPUT—Up 1.1% (Week ending June 7), Kwhr 11,681,000,000



Per Cent Change From Previous Year

	May 24	May 31	June 7
Total U. S. ..	−2.2	+2.8	+1.1
New Eng.	−1.4	+2.1	−0.5
Mid. Atlantic ..	−2.0	−0.4	−1.3
Cent. Ind.	−5.4	−2.0	−2.8
West Cent.	+2.6	+7.0	+4.3
Southeast	−2.9	+0.5	−0.1
South Cent.	−3.0	+17.0	+25.1
Rocky Mount. ..	+9.4	+18.1	+8.1
Pacific			
NW	−12.4	−9.9	−9.8
SW	+9.2	+5.4	−0.4

Seasonally Adjusted Index 228.4

Week Ago 226.9 Year Ago 226.3

Atomic Energy Commission requirements—1,050,000,000 Kwhr (Electrical World Estimate). Excluding AEC, Output increase was 2.2%.

A TWO-MINUTE PREVIEW OF THIS ISSUE

EVENTS ▶ **Economical A-power for everyday use may be just around the corner.** Pacific G&E Pres N. R. Sutherland says PG&E expects to achieve 8-mill power with second fuel core at the proposed Humboldt plant and to approach that figure with the first core (p 43).

With John McCone on AEC there will be fewer controversies with Joint Committee on Atomic Energy than during Lewis Strauss's term, say key Democrats. The Eisenhower appointee, a probable partnership backer, should have no trouble winning Senate's okay (p 43).

Duquesne Light is honored with Coffin Award for "initiative, farsightedness, courage" for its part in the Shippingport project (p 42).

What will the next 21 years hold for the electric utility industry? EEI Pres J. W. McAfee answers: gigantic growth, with total industry sales reaching the 3-trillion-kwhr mark in 1979, and peak load topping a half-billion kw (p 40).

MEETING ▶ **The heavy water power reactor is the most promising nuclear unit,** for seven very good reasons. This assertion came from E. C. Fiss of Carolina Virginia Nuclear Power Associates at SEE's recent engineering & operation section meet. For the latest on this and other important industry matters—new trends in load dispatching techniques; effects of cost cuts of electrical equipment on the industry; pros and cons of net leasing of vehicle fleets—turn to the comprehensive meeting report starting on p 55.

GENERATION ▶ **TVA's newly developed slot discharge detector singles out** problem generators. Its use permits early detection of damaged insulation—leading to reduction of repair costs, elimination of unforeseen outages, and improved service (p 50).

SUBSTATIONS ▶ **Another idea to minimize maintenance costs:** simplified and more economical procedures for painting power transformers are outlined by Niagara Mohawk Power Corp (p 51).

TRANSMISSION ▶ **Ever train one man to do the job of three?** The story of how Connecticut Valley Power Exchange found itself in these shoes—and found the way out—is told in an article describing selection and training of systems operations for CVPE's new operating center (p 44).

The problems of international power interchange, once complicated by a tangle of import regulations and currency exchange rates, has been happily resolved for eight European nations by the Union for Coordination of the Production and Transport of Electric Power (UCPTE). Under the guidance of UCPTE, power interchange in Western Europe has risen to over 5 billion kwhr per year, using an international grid with transmission levels of up to 380 kv (p 47).

What will EHV do for you? Prospects of steadily climbing transmission voltages make many formerly unattractive power sites appear as choice locations of the future. Companies may soon find more remote locations offer an impressive cost edge over present plants, whose proximity to load centers demands fuel transportation (p 52).

SELLING ▶ **"There's gold in them thar customers"** was the philosophy upon which CEI and Westinghouse based their new program to combat the recession. Under the seven-month "Reddy Prospector" plan, the utility's 4,700 employees will earn points, or "nuggets," for successful attempts in interesting area residents in buying electric appliances (p 84).

INDUSTRIAL ▶ **A new high frequency resistance welding process,** using a 450-kilocycle, 50-kw heat source, is turning out stronger and better quality welded steel pipes for an Azusa, Calif., firm. With the welder, which is equally effective on ferrous, nonferrous, and alloy tubing, 20,000 ft of steel pipe rolls off the lines each day (p 86).

MANUFACTURERS ▶ **Louisiana P&L can now get an automatic record** of power plant operating conditions with its recently installed transistorized general purpose digital computer. The new Operational Information System, first of its type, can tell the operator what is happening at 350 points around the plant at rate of 5 points per sec (p 64).

An instrument panel that acts as a major textbook in customer training is developed by Leeds & Northrup. Composed of 13 controllers and recorders that operate under actual conditions, it teaches students installation, application, and maintenance (p 64) . . . Automatic circuit reclosers that can be mounted quickly on frame structures between poles incorporate 46-kv reclosers (p 66).

NEW EQUIPMENT ▶ **Want a combination of fully accessible motors and standardization?** A new line of Westinghouse motors, with squirrel cage, wound rotor, and synchronous motors, comes in six basic enclosures and 30 frame sizes, instead of the 450 frame sizes previously available (p 79).

You can now obtain vault capacitors for underground manholes and vaults subject to immersion. The GE units come in ratings of 150 or 300 kvar, 4.16 kv . . . New HV switch, with cross toggle linkage, is designed to stay closed during high momentary current transients (p 79).

PEOPLE ▶ **Four executives move one more step up the ladder** at Otter Tail power. They are A. V. Hartl, who becomes executive VP; W. K. Nye, VP-electrical; R. O. M. Grutle, VP-production; and H. R. Cowles, chief engineer . . . Louisiana P&L's new VP's are C. L. Osterberger, A. E. Elliott, and W. H. Senyard (p 88).

New type of feedwater heater will be used at the 12.5-Mw Lansdale (Pa.) municipal plant. Four stages of direct-contact feedwater heating, all contained in a single vertical cylindrical vessel, will be placed next to the turbine. Extraction piping is shortened, feedwater flows by gravity, and interstage transfer and drip pumps and drain controls are eliminated.—**R. T. Cooney, J. A. Neren, and W. J. Fadden, Power, May 1958.**

TECHNICAL NOTES

Any comparison of methods for reducing peaking costs by reducing peak flows should take into account the capacity built into the system to give customers adequate service without too much voltage regulation between light and peak load periods. This saving in investment may not be a saving in "out-of-pocket" expense, but rather is in the nature of a future saving in capital costs.

Relatively thin parts can be used in gas turbine construction because of the low operating pressures. These thin sections permit rapid and uniform heat transfer and thus allow the gas turbine to be started and loaded in a short time.

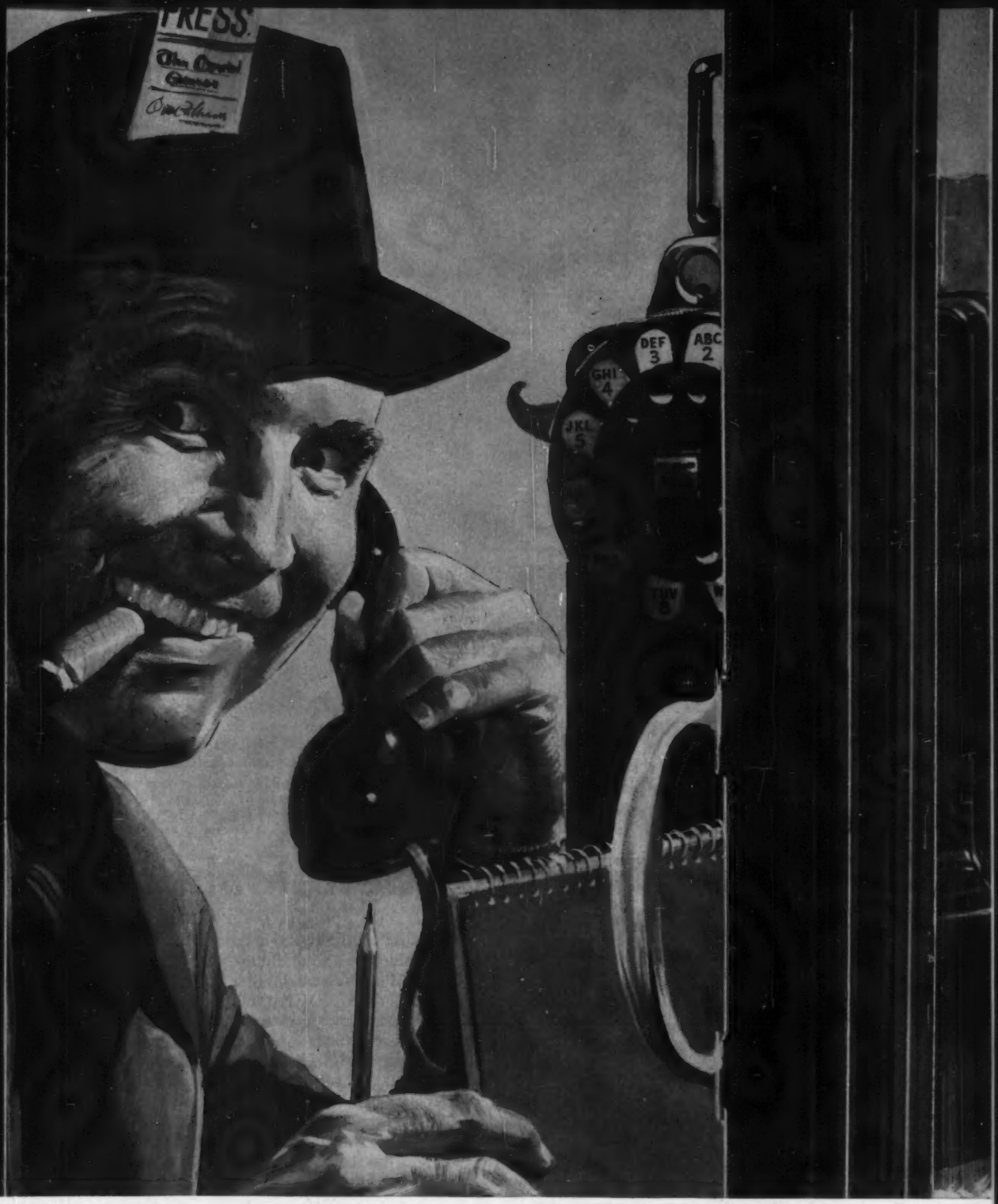
Elimination of both turbines and generators is the hope of a propulsion system under development by the Navy. System works on the thermocouple principle and holds promise of efficiencies higher than those attainable with present power plant cycles, naval sources claim.

Application of mercury arc converters (rectifiers suitable for inversion) to large reversing drives for steel mills may lead a step closer to dc transmission for which conversion equipment has been a problem.

FROM EDITORS IN THE FIELD

More dust gets into relays while covers are off for routine clean up than is removed from the contacts by the clean-up operation, according to Southwestern Gas & Electric engineers.

Bi-metal thermostats are reliable, inexpensive, and a simple means of controlling the switching of secondary capacitor units. Louisiana Power & Light Co sets the thermostats to switch on at 80F and off at 70F.



City desk?...Line Material will announce **SRT** on June 23rd!

SRT...**S** as in sensational...**R** as in revolutionary...**T** as in terrific!

L-M 6-Foot 4-Lamp Fluorescent Units in the main shopping center of Lake Geneva, Wisconsin. Units are at a 30-foot mounting height, at 55- to 60-foot staggered intervals. Each of the four 100-watt lamps provides 5700 lumens—a total of 22,800 for the luminaire, giving an average maintained illumination of 2.00 foot-candles, compared to .13 foot-candles of the old-style upright luminaires.

Lake Geneva Installs L-M Fluorescents For Better Lighting, Better Shopping

DEAN VAN NESS
City Manager
Lake Geneva, Wisconsin

"One of the most forward steps this city has taken in a number of years," says Dean Van Ness, City Manager, about the new L-M fluorescent street lighting system, recently installed in the beautiful southern Wisconsin resort city of Lake Geneva.

"City officials and citizens are well pleased with the appearance—both day and night. The lighting is most effective," adds Manager Van Ness.

The beautiful White Way layout in this well known resort center was created in cooperation with the Wisconsin Power & Light Company. L-M 6-foot shallow 4-lamp luminaires are mounted on 6-foot davit arm aluminum poles with 30-foot light centers. Poles are staggered at 55- to 60-foot intervals. The system gives an average maintained illumination of 2.00 foot-candles on the street, compared to .13 foot-candles of the old-style upright luminaires.

L-M fluorescent lighting like Lake Geneva's offers several important advantages. (1) Good lighting increases nighttime in-town shopping. (2) Traffic accidents are reduced. (3) Petty thievery is cut substantially, or eliminated, in lighted areas. In addition, L-M fluorescents provide low operating and maintenance costs. The special design utilizes the greatest proportion of the light with practically no glare. And L-M's unique wiring feature makes installation easy, fast, and economical.

Ask for Bulletin

Ask the L-M Field Engineer or Lighting Specialist for information on L-M's lighting application engineering for streets, shopping centers, and airports, and for a free copy of bulletin on L-M fluorescent outdoor lighting. Or write Line Material Industries, Milwaukee 1, Wisconsin.

McGRAW EDISON

319 R2

LINE MATERIAL Industries Outdoor Lighting

McGRAW-EDISON COMPANY

GATE HOUSE at entrance to Indian Lake Estates, country club community, with the professionally styled L-M Ovalite (Line 2A) mercury vapor luminaires mounted on double upsweep arms to light the dual-lane avenues. These provide uniform illumination of 4.2 footcandles on the roadways. Lights are turned on and off automatically by L-M photoelectric relays.

L-M Luminaires Light Florida's Beautiful Indian Lake Estates

High in the lake and ridge section of Florida, in the area around Lake Wales, is located a new private city, Indian Lake Estates. This is a multi-million dollar development, an exclusive country club community, providing exceptional beauty and outstanding recreational facilities for residents.

Lighting the palm-lined, dual-lane avenues are L-M Ovalite (Line 2A) mercury vapor luminaires. These luminaires, mounted on metal poles at 30 feet, have dual 8-foot upsweep arms. They carry 20,000 lumen lamps and provide uniform illumination of 4.2 footcandles on the roadways. Underground 240-volt wiring serves the luminaires, which are controlled by photoelectric relays.

In addition, a 1,100-foot private pier is lighted with L-M's famous Suburbanaire (Line 2B) open type units containing 175-watt mercury lamps and ballast. They are spaced at approximately 100-foot intervals along the pier and provide 2.0 footcandles of illumination.

Ovalite An Efficient Light Source

The Line 2A luminaires have a high coefficient of utilization. Additional advantages include: choice of Type II, III, or IV light distribution patterns, by simply changing lamps or socket settings; many features for safety and easy servicing, including L-M's exclusive "service-safe" socket; choice of series or multiple service.

Get Complete Information

L-M provides a complete, highly styled lighting line of incandescent, mercury vapor, and fluorescent units, with excellent application engineering help for utilities, municipalities, consultants and subdividers. Ask the L-M Field Engineer or Lighting Engineer about L-M outdoor lighting equipment. Or write Line Material Industries, Milwaukee 1, Wis. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.

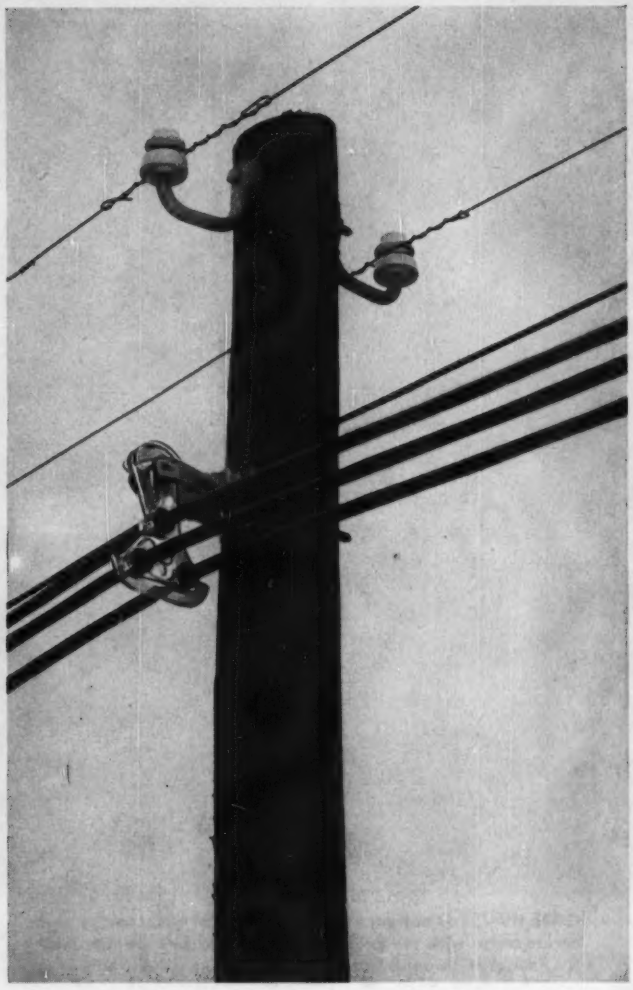
331-R

McGRAW EDISON

LINE MATERIAL Industries Outdoor Lighting

McGRAW-EDISON COMPANY

Conventional aerial system required cross-arms...tree-pruning is major cost and irritation factor with utilities companies.



New Roebling ROEPLASTIC Cable with ROECLAMP requires only *one foot* of clearance through trees! Note improved, compact appearance. No crossarms are needed.

Roeclamp is the key ...unit construction means no separate parts...installs without tools...Linemen go for it!

Here lineman has grommets mounted on conductors and messenger and is about to mount ROECLAMP over messenger . . . ease of installation means one crew can install more line footage per day . . .

New Roeclamp* with Roeplastic® Cable Costs 60% Less than Self-Supporting Cables, Minimizes Tree Problems, Installs with Ease, Looks Better!

New ROECLAMP with ROEPLASTIC Cable is the perfect answer in areas where trees are a problem, where appearance is an important factor, or in areas where the most compact, economical and easily serviced system is desired. That means *just about everywhere!*

Roebling ROEPLASTIC Cable with the remarkable new ROECLAMP, is designed for 5kv use (2400/4160Y and 4800 v delta systems) and 8kv use (4800/8320Y and 7200 v delta systems). Phase identification is positive at a glance, since cables are maintained in the same relative position along their entire length. Phases may be added or removed, and the system may be reinforced *without removing* ROECLAMPS from messenger! *Conductors may be replaced without tools* (except for splices and taps).

Low impedance results in better voltage regulation—and the heat-dissipating properties of the Roebling system mean higher current-carrying capacity. Lightning protection and protection from falling tree limbs are provided by the strong copperweld messenger, which runs the length of the system. Aluminum conductors come in 17 standard sizes and strand constructions to cover a broad range of applications. They are specially made with a greater number of finer strands to give extra flexibility. Standard insulation is extruded ROEPLASTIC P-11R7, although other types of extruded insulations are available, depending upon proposed usage.

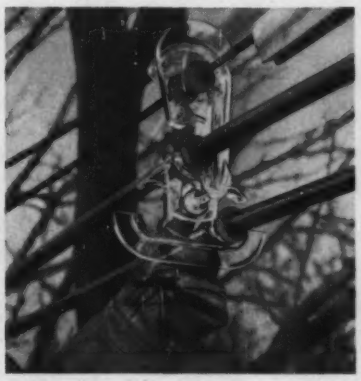
The Roebling Aerial Spaced Cable featuring ROECLAMP costs less, installs fast, gives optimum service and requires minimum maintenance. You can't afford not to investigate it! Your Roebling representative can give you a demonstration of the revolutionary new ROECLAMP—and will give you more facts. Call him—or write Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

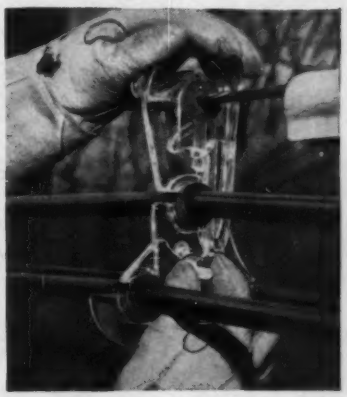
Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

* Patent pending

One motion and ROECLAMP is on messenger and ready to receive conductors. Phase changes and repairs do not necessitate removal of clamp. ROECLAMP comes complete with grommets to fit messenger and conductors you order . . .



Note how easily conductors drop into place. Installation is measured in seconds, even with "boxing" gloves on. ROECLAMP is Plexiglas†, tests to over 1000-lb. breaking strength, offers outstanding weather resistance, best possible electrical properties . . .



35 ROECLAMPS are required every 1000 ft. Installation is completed by hand-tightening of nut. Not even a screw driver is required!

† Reg. T.M.—Rohm & Haas Co.

Cut network costs three ways . . .

SPACE-MISER NETWORK ON ORIGINAL COST, MAINTENANCE

TRANSFORMERS SAVE INSTALLATION AND

Along with other leading utilities, New York State Electric & Gas Corporation has been quick to recognize the cost-cutting advantages of the SPACE-MISER transformer in their network operations. The SPACE-MISER offers a big three-way saving—whether for original or replacement installation . . . here's how:

Standard design saves on original cost. The SPACE-MISER meets all EEI-NEMA Standards and most customer requirements without modifications. There are no expensive "extras" normally required.

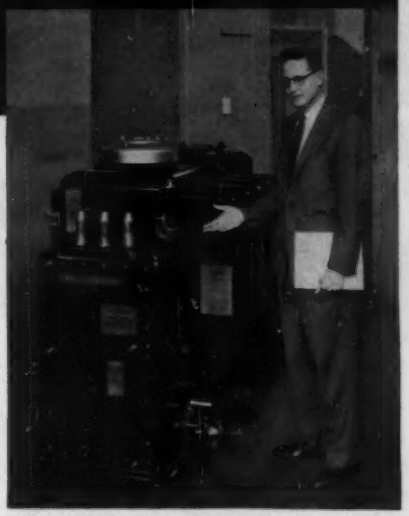
20% size and weight reduction cuts installation cost. New vaults can be built smaller. Existing transformers can be replaced with higher rating SPACE-MISERS, without vault alterations. Installation is faster, easier—handling safer.

New tank and coolers cut maintenance. The contoured tank and Yukon coolers provide smooth surfaces that readily shed corrosive materials. Streamlined design eliminates sharp edges where corrosion starts. Greater clearances between coolers provide easy accessibility for inspection, cleaning or repainting.

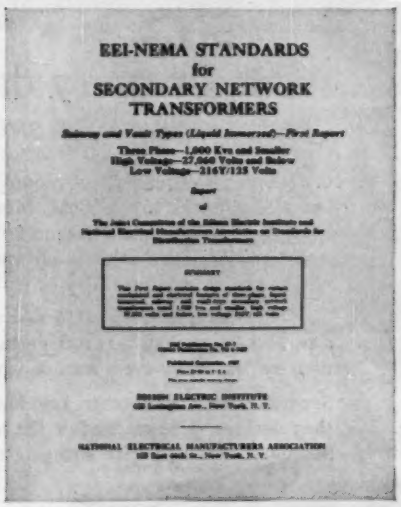
The all-important overload ability and long life required for network use have been fully retained, while providing these new advantages found only in SPACE-MISER.

Call your Westinghouse representative for the complete story of the SPACE-MISER . . . another development made possible through Plowback of Earnings into research. Or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-70871

Inside a network vault of New York State Electric & Gas Corp., Binghamton, N.Y.: another SPACE-MISER transformer installed by a customer who recognizes the advantages inherent in the SPACE-MISER design.

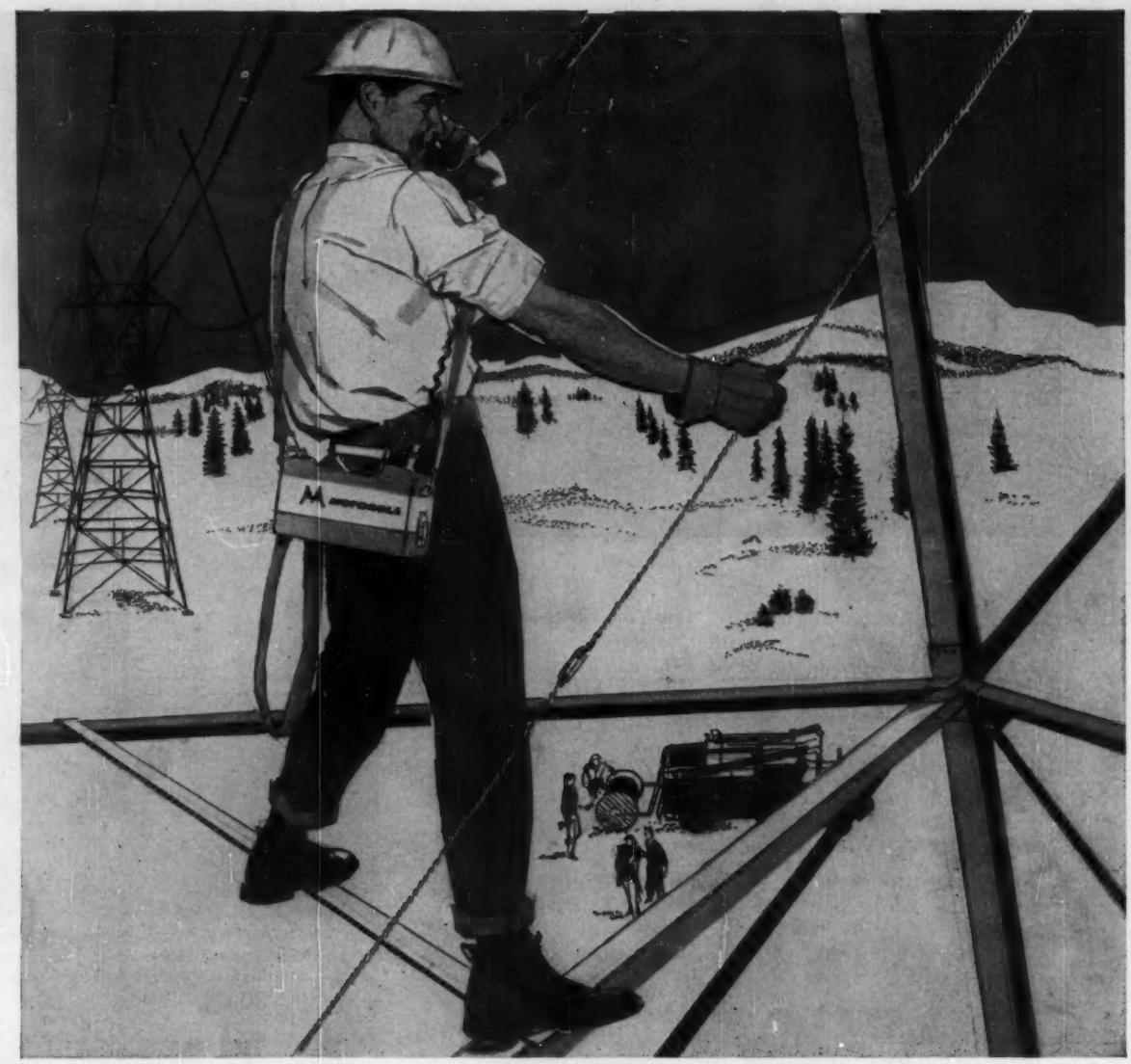


Mr. J. C. Gardner, Westinghouse network transformer representative at the Sharon, Pa., plant, illustrates the relative size of the outstanding SPACE-MISER.


EEI-NEMA STANDARDS
for
SECONDARY NETWORK
TRANSFORMERS

New EEI-NEMA Standards result in savings to the user of network transformers. Westinghouse was active in the leadership to promote these standards.

YOU CAN BE SURE...IF IT'S Westinghouse



"Almost every day we find <u>new</u> jobs for 2-way radio"

SAYS HARRY M. LEWIS, SUPT. OF COMMUNICATIONS, CALIFORNIA OREGON POWER COMPANY

Over canyons, streams and mountains, as well as in heavily populated urban areas, Motorola 2-way radio is helping The California Oregon Power Company construct and maintain electric service *faster, more efficiently* and at *less cost.*

The giant radio network of 16 base stations, 90 mobile sets, and 31 HANDIE-TALKIE® portable radiophones is used by practically every outside working team.

Superintendents and other key men are freed from their desks—can be reached on the job or in their cars. Survey parties and wire stringing crews use HANDIE-TALKIE portables to communicate, spanning long reaches faster and better—saving *hundreds* of dollars every day. Repair crews are more productive—get lines back in operation faster, keeping customers better satisfied. Line patrols in tractors and helicopters work safer and more efficiently with radio.

Whatever the job—Motorola 2-way radio can help you speed it at less cost. Specify Motorola for the most dependable, uninterrupted mobile communications. For a Motorola communications specialist on Power Utility problems—write, wire, or telephone.

MOTOROLA *2-WAY RADIO*

MOTOROLA COMMUNICATIONS & ELECTRONICS, INC. • A Subsidiary of Motorola, Inc. • 4501 Augusta Blvd. • Chicago 51, Illinois

Note how ordinary EMT split early in pressure test while induction welded CIRTUBE EMT (shown here unplated) held fast, surpassing UL requirements.

BETTER WELDING

on new CIRTUBE EMT means easier, split-free bending

THERE are many reasons why new CIRTUBE EMT will help you get faster, cleaner wiring jobs. Most of them are listed here.

One *big reason*, however, is *continuous induction welding*—by far the best technique available for making bead-free, split-free welds on high quality EMT.

It is virtually impossible to split an induction-welded EMT no matter how severe the bends. And the perfectly clean weld means uniform roundness—easier, neater bending without the slightest kink or flattening. Your men get it right the first time around.

Try induction-welded new CIRTUBE EMT soon as you can. Your wholesaler has it now—bundled with distinctive orange colored tape to identify the EMT manufactured to Circle's quality standards.

CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. SALES OFFICES & WAREHOUSES: in all principal cities
RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

CIRTUBE EMT *Ask for it!*

Proper steel plus! The best cold rolled steel plus the right handling give CIRTUBE EMT its natural bendability.

Easy fishing! A baked-on protective coating gives CIRTUBE EMT a built in lubrication for easier wire pulling.

Lifetime exterior finish! Hard galvanized finish for durability; polished satin lustre for lasting good looks.

Automated quality control! Automatic controls assure complete and continuing uniform quality of product.

Tight, easily handled bundles! Bright, orange tapes hold CIRTUBE EMT securely for easy handling on and off the job.

Fast, friendly service! Well-known Circle service through a nation-wide network of well stocked nearby warehouses.

You can replace *any* draw-lead bushing on your 69 kv system

with one of these LAPP POC* BUSHINGS!

Here's a real saving for you in simplification of warehouse inventories and reduction of costs! No matter how many types of transformers may be on your system . . . no matter how old they may be . . . any bushing replacement requirement can be met by the Lapp POC* ASA Standard bushing.

At 69 kv, for example, the Lapp POC* draw-lead (400 amp) bushing is made in just three shank lengths. Present transformer designs call for these bushings. On any older transformer using a pre-standard bushing, one of these will also fit perfectly; all that is required is a simple flange adapter which provides for differences in mounting details, and for length and clearances.

Lapp can supply POC* Bushings for your stand-by stocks in voltage ratings 15 kv to 161 kv. Also, we'll design and supply, at nominal cost, non-magnetic flange adapters which will adapt these ASA Standard bushings to every transformer on your system. Give us data on the transformer bushings you now have in service. Let us show you the economies you can effect by reducing your entire stock of spare bushings to the required sizes of Lapp POC* Bushings and a suitable assortment of flange adapters. You'll never be without the replacement bushing you need, and you will save spectacularly in warehouse space . . . in stock maintenance labor costs . . . in investment in inventory. Lapp Insulator Co., Inc., Le Roy, New York.

Lapp

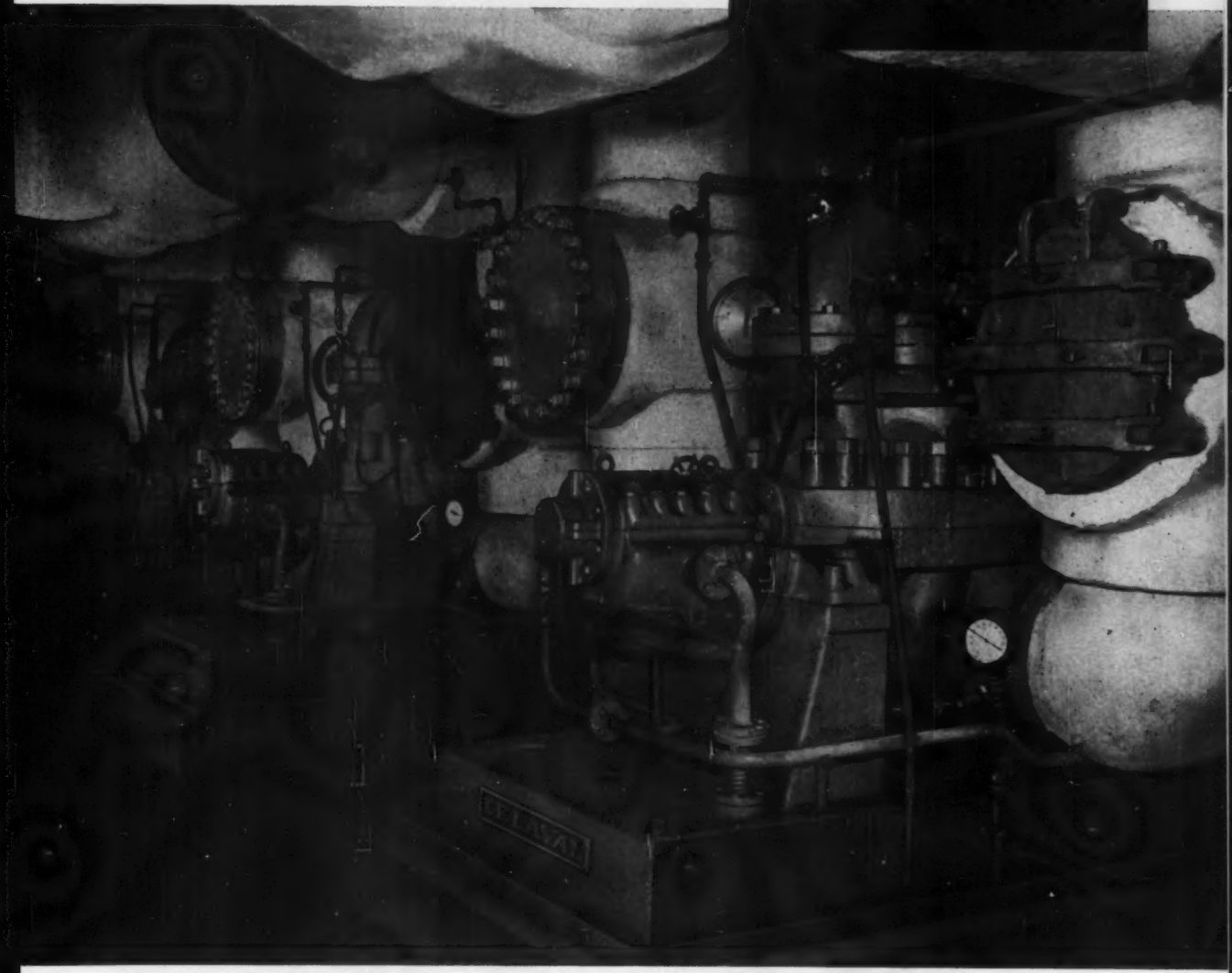
POC* BUSHING

*PAPER-OIL CONDENSER TYPE
TOTALLY-ENCLOSED CORE
ASA STANDARD

Con Edison *reorders*

DE LAVAL

BOILER FEED PUMPS



The three De Laval Oppeller Pumps, shown in the photograph, do a dependable job of handling boiler feedwater at the East River Station of the Consolidated Edison Co. of New York. These three-stage pumps, with double-suction in the first stage, have a capacity of 2,000 gpm and operate at a discharge pressure of 620 psig. As proof of their reliable performance, Con Edison has ordered two identical units for the expansion of this station *plus* similar pumps for their Indian Point nuclear generating station.

Excellent for *medium* pressure and temperature service, De Laval Oppeller Pumps are designed with opposed impellers that balance axial thrust. Standard design features include sleeve bearings and labyrinth wearing rings which assure long economical service.

For *high* pressure, *high* temperature boiler feed service, De Laval offers the barrel-type pump . . . a single-suction, radially split diaphragm type multi-stage pumping unit inside a forged steel barrel.

For more data on these dependable pumps, write for Catalogs 1502 and 1506

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

861 Nottingham Way, Trenton 2, New Jersey

DL 413

How Westinghouse Plowback of Earnings into Research brings you

POWER CIRCUIT BREAKER DESIGN AND PERFORMANCE IN A DISTRIBUTION BREAKER

A forward-looking breaker design program, coupled with thorough High Power Lab testing, produced the Type G frame-mounted, single-tank breaker . . . providing system protection and continuity of service unmatched in the industry! These distribution breakers are designed to the ASA Large Power Breaker Standards.

Top coordination of system relaying can be provided by separate phase and ground relays. Any type or combination of relays can be used to provide maximum flexibility. Varying system requirements can be met without changing basic breaker components.

The magnetic De-ion® grid and solder-sealed condenser bushing were adapted from big breakers to offer reliable high-voltage breaker performance.

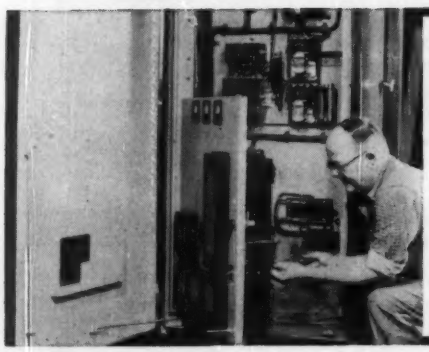
Exhaustive High Power Lab testing proved the soundness of the single-tank design . . . assuring big savings in inspection, adjustment and maintenance, plus the most efficient utilization of oil.

Type G breakers are available rated: 14.4 kv, 600-1200 amp, with interrupting capacity of 100-250 mva; and 23 kv, 600 amp, 250 mva. Maximum interrupting time: 5 cycles.

To learn how you can have big-breaker performance in your distribution substation breakers, call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-60958

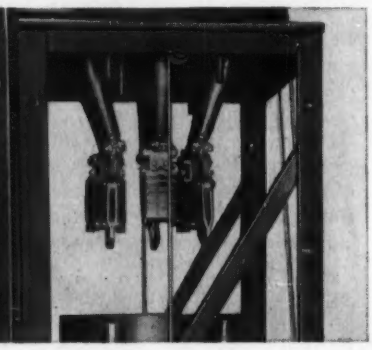
YOU CAN BE SURE...IF IT'S

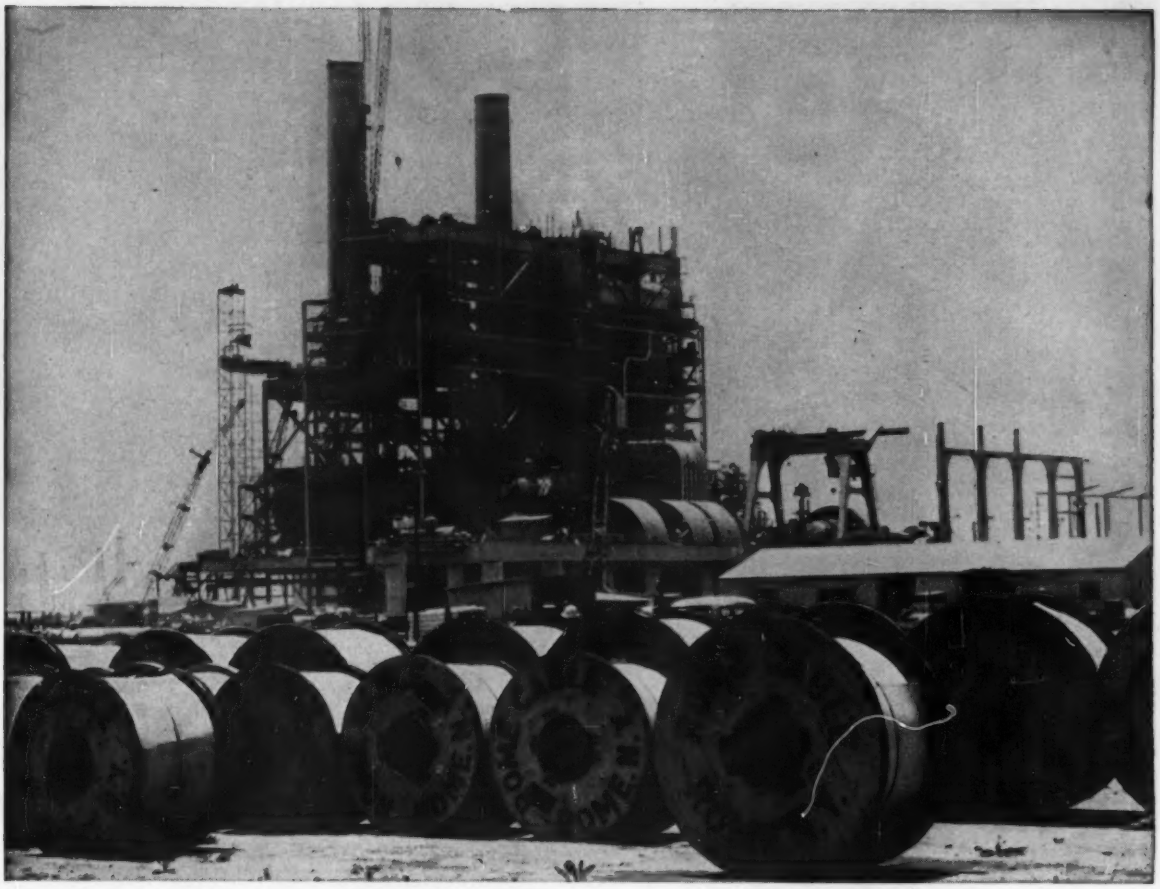
Westinghouse



Staggered interrupters give complete phase-to-phase insulation. Hinged moving contacts provide positive guiding action . . . simplest operating linkage. Since single-phase faults may occur more frequently on one particular phase, three phases in one tank make optimum use of all of the oil . . . minimize maintenance.

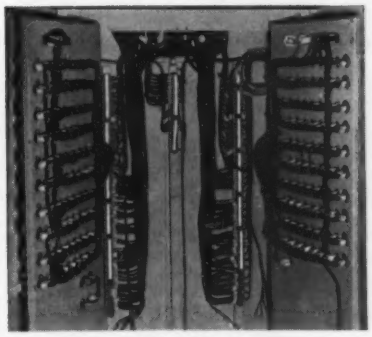
Relays and operating mechanism both located in cabinet of breaker to trim space requirements. Hinged relay panel provides easy accessibility for inspection or maintenance.





Southern California Edison installed...

¼ million feet of Rome control cable in the Alamitos steam station



EASY TO HANDLE, STRIP, SPLICE. The clean, low-friction surface of Rome's control cables enabled Alamitos workmen to pull the cable through conduits and into this cabinet quickly and easily.

For its station control circuits, this large West Coast utility selected high-quality Rozone-Roprene control cable —*253,000* feet of it. This Rome cable is a logical choice for any such permanent installation since it represents the ultimate in control cable design and performance.

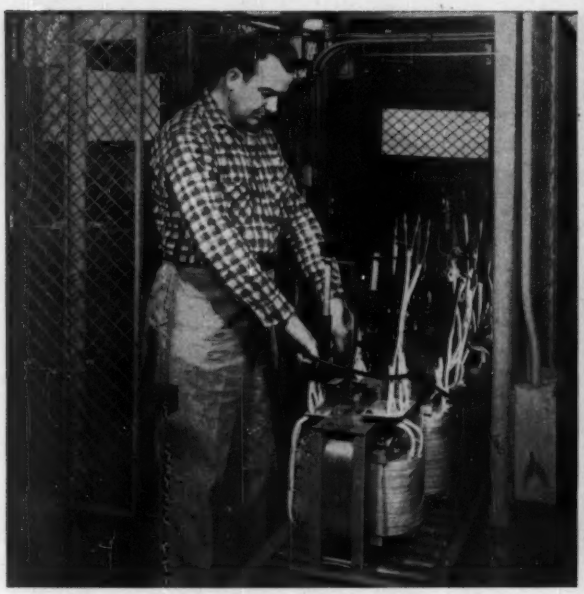
Built to last. Each conductor is insulated with a premium-quality, oil-base insulating compound—Rozone—which provides excellent protection against corona and ozone cutting. Rozone is also highly resistant to water and aging. Each individual conductor is then covered with a tight-fitting color-coded Roprene (neoprene) sheath.

Over-all protection is provided by a Roprene jacket, which not only resists weather, oils, chemicals, and even flame, but also provides a high resistance to mechanical injury during and after installation. And this tough Rome Cable material is virtually immune to corrosion and electrolysis.

If you want the very best in station control cable for your next job, specify Rozone-Roprene. Contact your nearest Rome Cable representative for more information—or write to Department 803, Rome Cable Corporation, Rome, New York.

ROME CABLE

CORPORATION



RATIO TEST double checks exact number of turns on each coil against automatic count of winding machines.

CORE LOSS AND COPPER LOSS TESTS determine the excitation loss, impedance and load losses at rated current.

WAGNER FORM W TRANSFORMERS PERFORMANCE-PROVED BY TESTS

The extreme care used in building Wagner Form W Distribution Transformers starts with advanced engineering design and rigid quality control of all materials used in the transformers. It is carried on by highly skilled workers through every step of assembly. And, it is *proved* by exacting inspections and tests to assure that every Wagner Form W Transformer has the ability to provide many years of trouble-free service.

Electrical tests at various stations along the production line include all commercial tests prescribed by ASA and NEMA. Mechanical inspection includes tests for possible leaks in welded seams or around bushings.

All Form W Transformers, in ratings 3 through 167 kva, 15 KV and below, are designed for pole mounting. Form W Transformers are available for every requirement of modern distribution systems—500 kva and smaller, 69 KV and below.

You can choose either conventional or protected type Form W Transformers for your distribution lines with full confidence that they will pay dividends in longer service life.

Bulletin TU-141 gives complete information on Wagner Form W Distribution Transformers. Write for your file copy today.

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SERVING INDUSTRY SINCE 1891

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

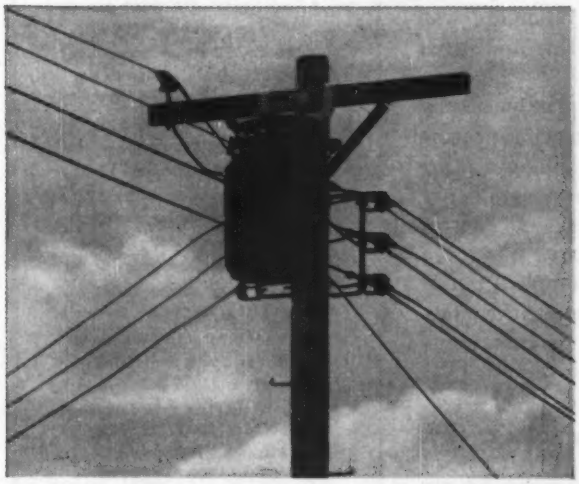
Wagner Electric Corporation
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

GROUND AND DOUBLE NORMAL TEST. Complete transformers are given dielectric tests for applied potential and induced potential.

IMPULSE TESTS prove the ability of every Wagner Form W Transformer to operate under greater stresses than it will meet in normal service.

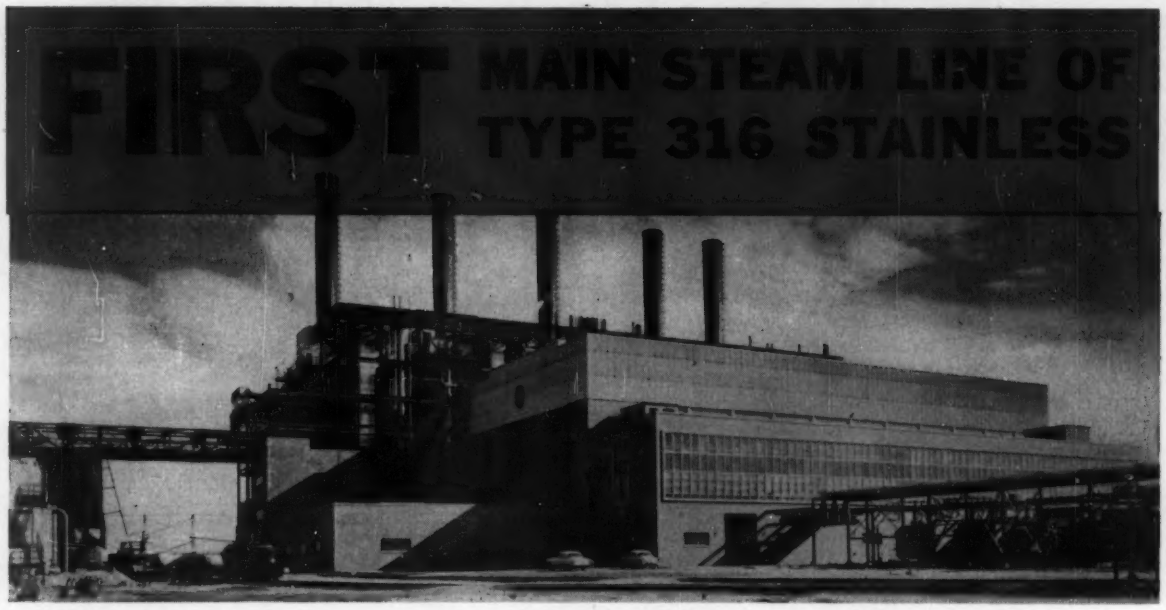
TO PROVIDE LONGER SERVICE LIFE!



Today's Wagner Form W Transformer is exactly right for modern distribution systems. Its small size and light weight make it easy to handle—to store—to mount on poles.

LIVE BETTER ELECTRICALLY

WT58-10



Linden Generating Station of Public Service Electric and Gas Company of New Jersey, where the first main steam line of Type 316 has been in service, on Unit No. 2, since December, 1957.

One of Kellogg's Many Power Piping Firsts

Public Service Electric and Gas Company's Linden Generating Station is the first utility plant to use Type 316 stainless steel for a main steam line. Installed in Unit No. 2, with throttle conditions of 2350 psi and 1100 F, this alloy piping is 11⅝ in. O.D. x 1⅜₁₆ in. minimum wall thickness. The M. W. Kellogg Company fabricated this and other critical systems for this unit.

Kellogg's long list of "firsts" in power piping fabrication is due largely to its continuing studies in search for new alloys and new fabricating techniques which will permit industry to achieve still higher operating efficiencies. Kellogg is now working with Public Service of New Jersey on the main steam and other critical lines at Bergen and Mercer generating stations, utilizing austenitic and ferritic alloys.

Kellogg welcomes the opportunity to discuss its complete power piping design, fabrication, and erection facilities with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and auxiliary equipment.

Fabricated Products Sales Division

THE M.W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N.Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

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FIRST IN FABRICATION OF:

- Piping from C. ½% Mo.
- Station piping for 900 F.
- Station piping for 950 F.
- Station piping for 2200 psi.
- C. ½% Mo. piping with #3-#5 actual grain size
- 1¼% Cr.-½% Mo. steam piping
- Steam piping for 1000 F.
- ½% Cr.-½% Mo. station piping
- 2% Cr.-½% Mo. station piping
- Station piping for 1000 F.
- 2¼% Cr.-1% Mo. station piping
- 1¼% Cr.-½% Mo. station piping
- 1% Cr.-1% Mo. V. turbine piping
- 2¼% Cr.-1% Mo. V. station piping
- Station piping for 1050 F.
- 3% Cr.-1% Mo. station piping
- Type 347 stainless turbine piping
- Mercury vapor piping for 1000 F.
- Station piping for 1003 F. for France
- Type 347 stainless station piping
- Station piping for 1100 F.
- Type 316 stainless station piping
- Type 316 stainless station piping for 3500 psi-1050 F., 325 MW.
- Type 316 stainless station piping for 5600 psi-1200 F., 325 MW.

POWER PIPING—THE VITAL LINK

Editorial Comment

June 16, 1958

"Where Principle Is Concerned, Be Deaf to Expediency"

"I believe the moral losses of expediency always far outweigh the temporary gains."
WENDELL L. WILLKIE

Checking the source of the quotation that is the title for this editorial, we came across the one below it. That it should have been said by Wendell Willkie, once a leader in our industry, is particularly fitting, for many of us are involved today, or will be involved shortly, in an issue which touches upon the fundamental fibre of our way of life. It is the issue precipitated by the recent Internal Revenue Service ruling that some of the advertising of the investor-owned electric utilities is not deductible for tax purposes. To some it may appear that the matter is not a very important one—after all, the monies involved in most cases are not very great. But more, much much more, than money is at question here.

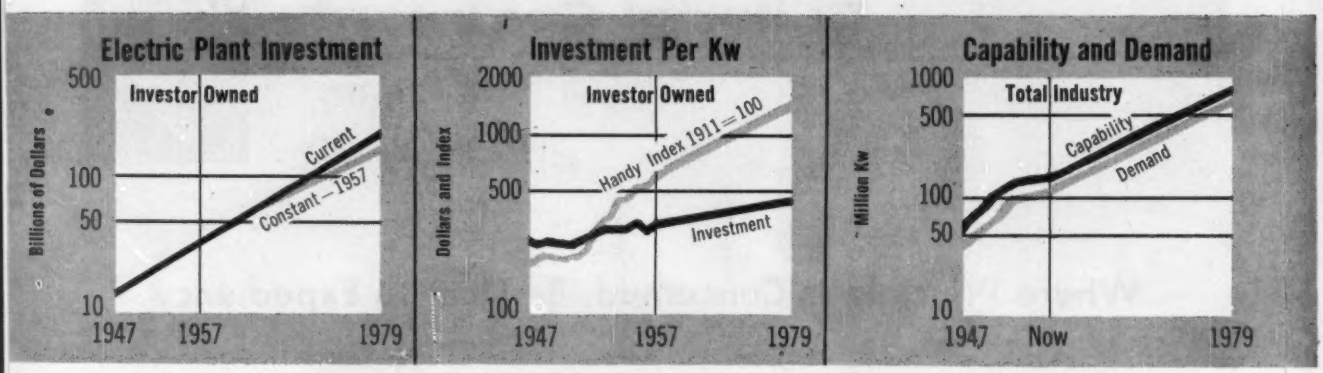
What is involved here is not so much the issue of private vs federal power, but the basic, more fundamental one of a fair and equal shake for everyone, for the right of each of us to bring his case before the people under the same conditions. And all the political sophistry of a Kefauver saying, ". . . *They can continue to propagandize as much as they want in their advertisements—they are merely going to have to pay the bill themselves. They can no longer charge the taxpayers and rate-payers for their own brain-washing*" . . . should not be allowed to obscure this central fact.

The *legal* right of the privately owned utilities to tell their story is threatened by the *political* fact that the federal government happens to be their competitor. At the same time, the government can and does tell its story not merely without government interference, but with government support, and at the taxpayers expense!

And when government is permitted to perpetrate, and then maintain such a condition of manifest unfairness toward a particular group of its citizens, then all of us have lost a little piece of freedom. And even a cursory review of history will show that absolutism is achieved like freedom is lost—in little pieces.

It behooves us therefore, both as private citizens and as custodians of the energy that can be rightly called the lifeblood of our civilization, to stand up and resist this ruling in every fair and legal manner possible. To do anything less, under the pretense that the game is not worth the candle, will be at best a sham, and at worst, selling our heritage short.

Principles, important principles are involved, and where principle is involved, be deaf to expediency.



The Next 21 Years: EEI Sees

In 1979 total sales will hit 3 trillion kwhr and peak load will top half a billion kw. Here are projections from Edison Electric Institute's brand new long-range industry forecast

The charts on these pages tell the story of the U. S. electric power industry for the next 21 years, as seen through the eyes of the Edison Electric Institute.

It is a story of tremendous growth: by 1979, the centennial of Edison's electric light, total industry sales will reach 3 trillion kwhr, says EEI; electric companies will have $221 billion invested in plant; and their annual revenues will total about $50 billion.

Outgoing EEI Pres J. W. McAfee told the story last week at EEI's 26th annual convention in Boston.

Labeling the current recession "a breathing spell," McAfee pointed out that "in the past readjustments like this one have been followed by greater gains in the economy than before."

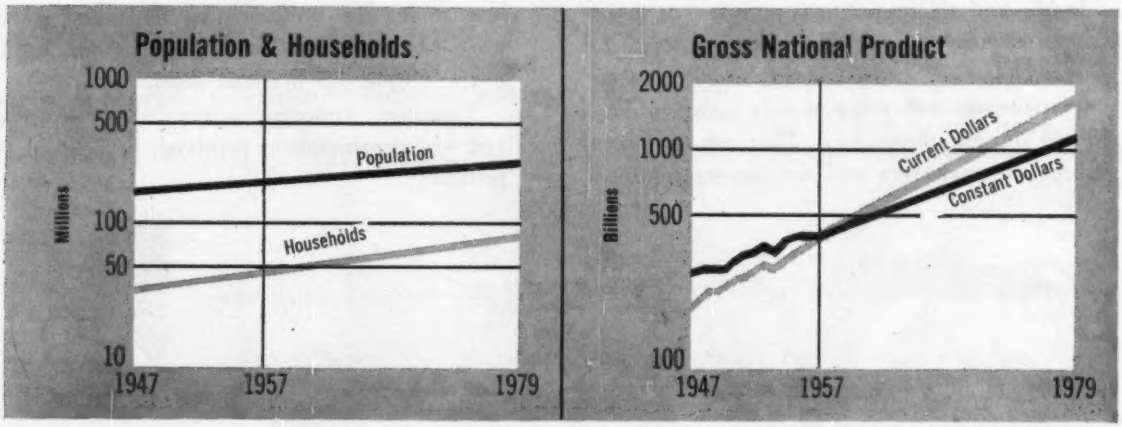
Consistent Conservatism

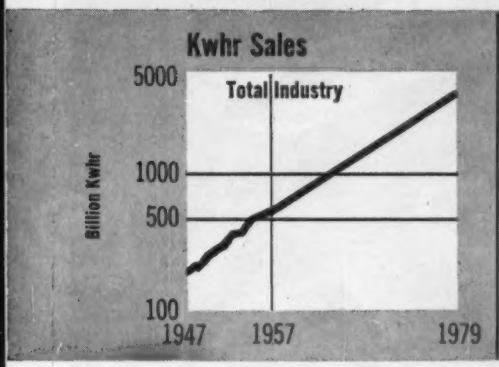
Formerly, he said, "Our industry has always been conservative in predicting the magnitude of its future." He stressed that the consistently low estimates of the electric industry's growth were not based on the objective use of statistics, because the growth they indicated was so great that it seemed hard to believe.

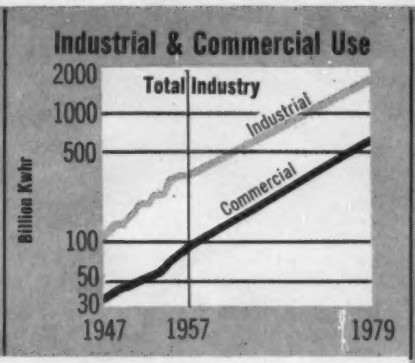
EEI based this objective forecast on several assumptions:

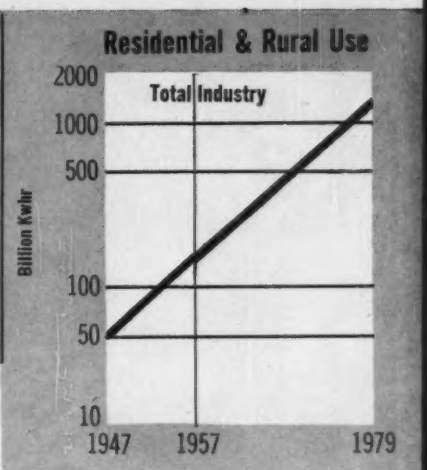
1. There will be no shooting war prior to 1979.
2. The U. S. economy will continue its growth.
3. The American people will not adopt socialism; government's role in the economy will move along lines already established.
4. Inflation will continue.
5. There will be no significant changes in tax structure.

In arriving at its forecasts of the electric industry in 1979, EEI drew on some predictions of the course of the economy as a whole. Below are the expected trends of population and formation of households in the U. S., and of the gross national









Gigantic Utility Expansion

product (total value of all goods and services produced).

They are plotted, as are the other charts, logarithmically. This allows the constantly rising trend of past performance to be projected more readily, in the form of a straight line.

A Gain of 2/3 in Households

U. S. population by 1979 is expected to reach 250 million—nearly half again the present total. Households will total over 82 million, about ⅔ more than last year. Gross national product is estimated at $1 trillion in 1957 dollars, with inflation adding another $700 billion.

For electric industry data, EEI trended the record since 1933 and projected it to 1979. Here's what the projection showed:

By 1979, electric company plant investment will be about $221 billion—nearly six times the $36.5 billion at the end of last year. In terms of 1957 constant dollars, the total would be about $174 billion. The rest is inflation.

Investment per kw will rise less rapidly. By 1979 a kw of capacity will cost about $450, up from $375 today. But bigger and more efficient units will keep the rise well below that of the Handy-Whitman index of over-all utility construction costs.

Total electric plant will reach 665 million kw by 1979—nearly five times the total at the end of 1957. More than 75% of this capability, about 500 million kw, will be in the plants of investor-owned electric companies.

This total capability will allow a 15% reserve margin over expected peak load of 578 million kw.

Annual sales will multiply five times in the next 21 years, according to EEI's projections, reaching about 3 trillion kwhr. To arrive at this figure, the Institute estimated an 8% annual growth, with a doubling of sales every nine years.

Residential and rural sales will make up a larger portion of the total in 1979 than they do today. Last year residential and rural users bought about 28% of the kwhr sold. By 1979, EEI predicts that those categories will account for better than 35%, totaling 1.1 trillion kwhr.

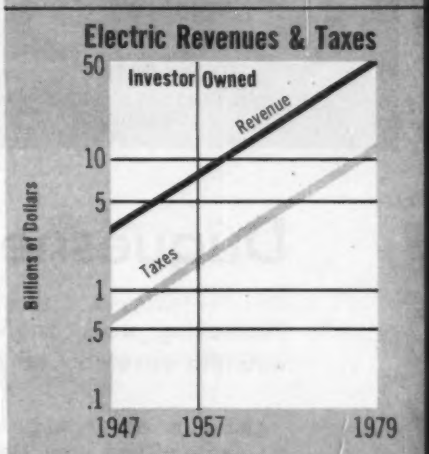
McAfee noted that EEI had included the effects of adding about 1½ "phantom" appliances a year—new home applications of electricity which are not now foreseen.

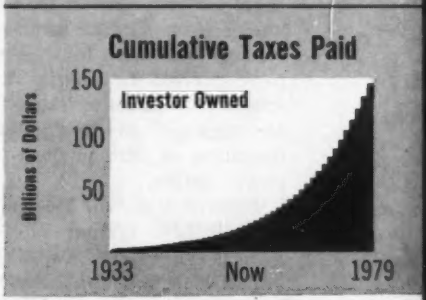
He also noted that dramatic increases in the heating and lighting load might push rural and residential use up even more than the seven-fold increase predicted.

Industrial and commercial sales are also in for impressive gains. According to EEI, power purchased by industrial customers in 1979 will total about 1.3 trillion kwhr—more than 4½ times the 283 billion kwhr used in 1957. Commercial use will be 533 billion kwhr—5½ times last year's $95 billion total.

Rising sales will boost electric companies' annual revenues to about $50 billion by 1979—over six times the 1957 record of $8 billion. EEI estimates that these revenues will produce the return on investment needed to assure a continuing flow of capital for expansion.

Taxes paid by electric companies to local, state, and federal governments will approach $12 billion in the year 1979. Between now and then, EEI estimates that $122 billion in taxes will be collected through electric bills—bringing the total collected since 1933 to $141 billion.





Duquesne Light Receives Coffin Honor

Pioneering work on Shippingport nuclear power station wins the coveted Charles A. Coffin Award at EEI meeting

One of the industry's highest honors was conferred upon Duquesne Light Co last week at the 26th annual Edison Electric Institute convention in Boston, Mass. The company received the Charles A. Coffin Award for "initiative, farsightedness and courage" in development and operation of Shippingport nuclear power station.

Described as "the electric industry's highest symbol of achievement," the Coffin Award is presented each year as a tribute to the memory of the late founder of the General Electric Co. Presentations of the annual gold medals and $1,000 awards began in 1922. The money goes to recipients' employee benefit funds.

Duquesne Light, which is headquartered in Pittsburgh, was chosen for the award through a series of nominations by a panel representing all sections of the nation. A review committee analyzed the nominated companies' accomplishments, then a Committee of Judges made the final decision. Judges were Dr John D. Ryder, dean of engineering, Michigan State University; C. W. Kellogg, past president of EEI, and J. W. McAfee, immediate past president of the Institute.

Overall Contribution Cited

Their decision was based, the citation reads, on Duquesne's "participation in the design and construction, and in its pioneering operation, of the world's first full scale nuclear power station devoted exclusively to peaceful purposes . . . and for its overall contribution to the development of nuclear power."

Three other utilities had also been nominated for the annual award by the review committee. They are Commonwealth Edison Co, Consolidated Edison Co of New York, Inc, and Idaho Power Co.

Built under the supervision of the Atomic Energy Commission, the Shippingport plant reactor was manufactured and installed by the Westinghouse Electric Corp. Duquesne Light contributed $22.5 million towards the costs of the reactor, furnished the site, designed and built the generating part of the plant, and is operating the station.

The project, which has been in operation since last December and was dedicated on May 26, can provide a minimum electrical output of 60,000 kw. It has a capacity of 231 Mw of heat.

The plant was designed with a dual purpose: 1) to aid in the development of atomic power by providing experience and data in the technology of pressurized-water reactors for the entire industry, and 2) to provide electrical power for the Pittsburgh area.

In spite of the fact that the plant was not designed to compete costwise with conventional fuels, AEC expects that its development and operation will "provide information from which reliable cost estimates can ultimately be made for plants of this type." Power cost at the busbar is about 65 mills per kwhr.

In the aerial photo above, the long dark building houses the nuclear portion of the plant. Surrounding this main structure are the auxiliary buildings, which include maintenance, storage, and office facilities.

McCone Tabbed as Next AEC Chief

John A. McCone, Los Angeles businessman nominated to succeed Lewis Strauss at Atomic Energy Commission, is expected to continue the "partnership" approach to A-power reactor development.

However, comments from congressional Democrats point to one conclusion: the 56-year-old Republican—who served in the Pentagon during the Truman administration—will enjoy much smoother relations with the Joint Committee on Atomic Energy than has Strauss.

Rep Chet Holifield (D-Calif.), one of JCAE's most outspoken advocates of a stepped-up federal reactor construction program, said:

"I don't know Mr McCone personally, but everything I've heard about him leads me to believe he's well qualified for the job. I would expect him to be confirmed by the Senate without a dissenting vote from either Republican or Democrat."

Eisenhower's nomination came a day after the announcement that Strauss—AEC chairman since 1953—had decided to step down when his term expires June 30.

The White House has avoided public commitment on whether McCone will be chairman, or only a member, of AEC. But it is assumed he will be named chairman.

Strauss' decision to leave is believed to have been based on three factors: Mrs Strauss' desire that he rest after years of public service; the increasingly bad feeling between Strauss and several JCAE members—particularly Sen Clinton Anderson (D.-N.M.); and his disappointment in being overruled at White House level on his opposition to cessation of atom bomb testing.

Eisenhower has asked Strauss to serve as special assistant to promote the atoms for peace program. Strauss, in this capacity, is expected to lead the U.S. delegation to international conference on peaceful uses of atomic energy in Geneva.

McCone comes to the new post with an impressive background in business and government. He is president and director of Joshua Hendy Corp, and board chairman of Pacific Far East Lines.

McCone came to Washington in 1947 as a member of Truman's Air Policy Commission, then stayed on as deputy to Secretary of Defense 1948. He was under secretary of the Air Force in 1950 and 1951.

McCone's specific views on atomic energy matters will be more apparent after his nomination hearing before Senate members of JCAE.

Strauss' Democratic critics on Capitol Hill fear that, in his roll as atoms for peace advisor to the President, he will continue to play a behind-the-scenes atomic role.

The admiral's "two hat" status—as AEC chairman and atomic energy advisor to the President—is one thing that has irked Democrats.

Some Democrats, for example, think Strauss "sabotaged" the informal agreement on an atomic power program reached recently by representatives of AEC and the joint committee at the White House level.

As a result, Democrats find the Administration's newly submitted five-year program inadequate.

The program, submitted to the Joint Committee June 4, sets the goal of attaining competitive nuclear power in this country within ten years, and in friendly foreign nations in five.

However, it does not abandon the Administration concept that private enterprise should be given first crack at reactor projects.

McCONE: Confirmation expected

Competitive Atom Power Seen

PG&E President predicts 8-mill power from proposed 60 Mw plant which will operate at 90% capacity factor

Pacific Gas & Electric Co believes it has broken the economic barrier to everyday use of atomic electricity, N. R. Sutherland, president, PG&E Co, recently told attendants at the Nuclear Energy Colloquum of California Institute of Technology. Sutherland specifically referred to the 60-Mw Humboldt Bay nuclear plant PG&E proposes to build by mid-1962.

PG&E expects to achieve 8-mill power with the second fuel core in the Humboldt plant and to approach the 8-mill cost with the first core. Capacity factor is estimated to be 90%. Because the Humboldt region is somewhat remote and because it is a relatively high fuel cost area, the 8-mill nuclear power will be competitive.

Sutherland told his audience that the capital cost of the nuclear plant would be greater than a comparative steam plant ($20 million vs $11 million) but with oil priced at $3 per barrel in the Humboldt region the atomic electricity breaks even with conventional steam power.

PG&E's studies also show that a larger nuclear plant could become competitive with the most efficient steam plants using $3 oil when capital costs of nuclear plants are reduced to about $270 per kw.

The cost of the first fuel core,

including all material and fabricating cost, except the uranium itself which is rented from the AEC, will not exceed $3 million, said Sutherland. The fuel elements will be warranted for a life of 10,000 MWD per ton of uranium. The second core is estimated to cost $2 million. An exposure of 15,000 MWD per ton is expected.

PG&E engineers are optimistic about nuclear operating and maintenance costs, according to Sutherland. They base their optimism on the very favorable operating record of the 5-Mw boiling water reactor at the Vallecitos laboratories of the General Electric Co. PG&E operates the conventional portion.

Sutherland felt that the capacity factor of 90% used for the cost studies was proper. The nuclear unit should produce for the Humboldt region and the system all the kwhrs of which it is capable because the atomic fuel cost is less than half that required to generate that same kwhrs from conventional steam plants.

Corette Warns of NW Threat

The proposed "Columbia River Development Corp" is "dangerous to the welfare of the region" and "a serious threat to the entire nation," says J. E. Corette, president and general manager of the Montana Power Co.

Corette testified before the Senate Public Works subcommittee on legislation by Sen. Richard Neuberger (D-Ore.) that would place all hydro-electric marketing and development in the Pacific Northwest in the hands of a federally-appointed agency—"is merely an attempt to impose upon the people of the Pacific Northwest, by another name, the type of valley authority legislation that has been discredited and opposed many times."

He charged that enactment of the bill would:

1. Create a federal agency with "an enormous concentration of economic and quasi-political power that would threaten the rights and freedom of the people in the region."

2. "Destroy the principle of state government and states rights."

3. Remove congressional control over financing of power projects in the Pacific Northwest.

4. "Create additional burden on the taxpayers by promoting subsidized federal power. . . "

5. "Emasculate the licensing authority of the Federal Power Commission" and "add another layer of federal control and regulation over the power operations . . ."

6. "Be socialistic in nature, and is designed to expand public ownership in the region."

The power corporation bill has received general endorsement of Oregon Gov Robert D. Holmes, who says the measure provides a "way to counteract the present tendency to build the wrong dams in the wrong places at the wrong time."

Foundation Takes Form at Yankee Plant

Construction at Yankee Atomic Electric Co's nuclear power station is maintaining a good pace. Reinforcing steel work, above, will support concrete columns, which will carry the primary reactor system. The vapor container steel shell for the 134,000-kw plant is to be 125 ft dia. Construction on the $50-million facility has been underway for about four months. Per unit cost will be about $345 per kw.

EHV Is a Hot Topic as CIGRE Meets in Paris

Power system engineers from 25 countries met June 4-14 in Paris at the 17th convention of CIGRE—the International Conference on Large Electric Systems.

Interest in early sessions centered on Electrique de France's conversion to a single circuit 380-kv operation from a 225-kv double circuit line running 279 mi from the Alps to Paris.

Later, delegates discussed increases from 400 to 500 kv in Russia and Sweden and Russian studies of a 600-kv system for Siberia.

U. S. experts presented eight of the 130 technical papers. These included a report on high-altitude experiments with 345 kv now underway in the Rocky Mountains, and a recapitulation of American Electric Power Corp's 23 years' experience with high-speed power circuit breakers.

Philip Sporn, AEP president, headed the 32-man U. S. delegation. Consolidated Edison Co's C. W. Franklin was coordinator of U. S. papers.

CVPE Selects, Trains Operators

Screens through aptitude tests; puts applicants through classroom and on-job courses

R. N. YOUTZ, Chief System Operator, Connecticut Valley Power Exchange, North Bloomfield, Conn.

Qualified dispatching personnel were a prime need of the Connecticut Valley Power Exchange upon its recent removal to its new system operating center at North Bloomfield, Conn. This need was foreseen by the management committee composed of personnel of CVPE and the participating companies, Hartford Electric Light and Western Massachusetts Electric.

The committee set up procedures for recruiting, screening, and training men for the complex operations associated with the exchange's expanded role. These men would be responsible for handling CVPE's newest function—the dispatching in detail of all switching and operation of 69 and 115-kv lines and substations of the two participating companies.

But when this exigency was recognized, the committee faced the fact that at that time no shift operating men were available who were familiar with operating practices of the three organizations involved and only a few with the operation of two. The committee prepared job descriptions for two system operator positions, for the man responsible for loading and for the man responsible for switching. These became the benchmarks for selecting the men and training them.

Adapted from a paper presented to EEI System & Equipment Committee, May 13, 1958.

Notices were posted in CVPE and the participating companies. These stated the educational and experience requirements and advised that applicants would be examined for physical and emotional fitness. These drew 25 applications.

From the applicants, management had to select the more competent men who could work together and could be trained for the job. Selection had to be carried out with a high degree of objective fairness, so that those not selected would continue to function efficiently in the overall operating team.

Histories Studied

As many applicants were not known to the management group, its members had to study each applicant's comprehensive application and past record. Discussions were held with each applicant's present and former supervisors, and each was interviewed separately by two men of the management group. Emphasis in the medical examination was on good general health, sight, and hearing, and absence of color blindness. Aptitude tests and interviews were conducted by an outside professional organization.

During this screening process, several men voluntarily withdrew their applications. Seniority, applicants were advised, would be considered only when all other factors appeared to be equal, a situation which did not arise. All of these criteria were used in the selection of ten of the remaining 20 men for continued progress in the program. Eight were needed to fill system operator positions, the two additional men being an insurance against losses and for future system operator work.

Connecticut Valley Power Exchange's station and interconnection loading responsibilities had to be carried out during the period of the training program. These took five shift men. The training itself was preparation for a non-existent position, and the training program had to be completed in a short fixed time.

Of the ten shift operating men selected for the training program, five were CVPE men carrying out the loading responsibility at that time. One was a load dispatcher; four, station operators of the participating companies. Accordingly, the first step was the transfer of the latter five to CVPE. Intensive on-the-job training prepared these men for carrying out station and interconnection loading responsibilities. Completion of this phase of the program provided ten men qualified for this assignment.

Men assigned to each group were carefully picked to balance the combined knowledge of participating companies' operations within each group. On alternate weeks, one group of five men carried out the loading responsibilities, the other group going into the classroom and the field. The classroom-and-field part of the program, designed to reach an objective in a limited time, was based on a study made by the Pennsylvania Electric Association

Systems Operation Committee. Its schedule was as follows:

Orientation, two days
Technical Training
Mathematics, two days
Electrical Theory, eight days
Basic Training, 58 days
On-the-Job Training, 30 days

CVPE alloted the number of days to each item.

Classroom presentations included lectures and discussions, the latter being stressed. The entire program was geared to the practical consideration of preparing trainees to start as system operators, not to turn out finished system operators.

Logs Supply Problems

The technical training reviewed mathematics and electrical theory only up to the required knowledge for daily system operation, all problems and examples coming from log sheets of the participating companies. The basic and on-the-job portions were interwoven to mitigate possible monotony and to allow the men to inspect equipment in the field shortly after class discussion of the equipment. Backbone of the basic training was the 40 days devoted to operating instructions. In that time, the operation of all generation and transmission equipment was discussed in detail until instructor and class had raised and answered all pertinent questions.

Switching Enacted

For example, in discussing an operating instruction for a transmission line, matters brought up included: Ownership, responsibility for maintenance, dispatching jurisdiction, normal connections, notification of changes in connections, capability of switches, interlocking, relays, load limits, supervisory control, automatic reclosing, metering, arrangements for switching at unattended locations, abnormal operation, procedures for taking the line out of service for work, and location of faults.

The switching and tagging for taking the line out of service for work and returning it to service were enacted by the group as in actual operation, one man playing the role of system operator and the others the roles of station operators, switchmen, and workmen. Their activities ended with the issuing of the clearance to the workmen. In these mock switching operations, all communications, clearance requests and reports, switching, tagging, grounding and plugging of the system diagram board were handled realistically. Each enactment was followed by a period of constructive criticism in which all joined.

After class study of the line, the group proceeded to field study, inspecting equipment and talking to station operators, switchmen, and workmen involved in the operation. System components were assembled, and past system disturbances, ac board studies, and hypothetical operating problems were reviewed. Each group gave two days to studying the ac board as applied to present and future operating problems, many of which were suggested by the trainees.

Visual Aids Used

Instructors were CVPE supervisors, assisted by supervisory personnel of the participating companies on specific subjects, such as relays, safety, and equipment nomenclature. By the time only operating instructions and field trips remained to be covered, the trainees' confidence and experience was such that one man from each group could be assigned as discussion leader. Thereafter the groups operated the classes, the instructors acting as consultants. Drawings, annual reports, maps, photos, sound-slide lectures, motion pictures, actual equipment, and laboratory setups were included in the instructional materials. Text books covered mathematics, electrical theory, electric system operation, transmission and distribution systems, steam and hydro stations, and relays.

To keep instructors and trainees directed toward the objective, 16 written examinations—roughly one a week—were given. Each examination, consisting of 25 questions, was discussed after the papers had been corrected, graded, and returned to the trainees. These discussions frequently indicated matter not previously touched on, and such matter was then considered.

"Bull" sessions relieved the monotony of formal instruction, usually when it was too late in the day to pass from a completed subject to a new one. Trainees and instructor took turns posing verbal questions and difficulties. Thus an important byproduct of the program was the development of a considable *esprit-de-corps*.

Sit-ins Invited

About midway in the program, interest in the participating companies became such that supervisors, operators, and maintenance personnel from those organizations were invited to sit in on the discussions. When an unlooked-for extra month became available to each group at the end of the program, it was used for review and study of system changes during the program. By this time the trainees were making hopeful inquiries about getting started on the actual work.

Meanwhile the shift position manned every other week by the trainees did not stay fixed; two new sharing units and the Connecticut Electric Exchange were placed in operation. The operation was moved from its former quarters to the new operating center, this transfer being accompained by changes in the communications and telemetering systems. Manual control of tie lines was replaced by automatic control. Classroom time was devoted to these developments.

Five men were appointed System Operator-A, the higher rating, and three, System Operator-B at the program's completion. By then two had voluntarily withdrawn.

Effectiveness Gauged

The effectiveness of the selection procedure has been demonstrated by the performance of the men in the training program and in their limited operating performance to date. The program proved aptitude testing to be a valuable tool in the selection procedure and an effective check on other yardsticks. Carried out by an outside professional organization, aptitude tests assured the more experienced men that every effort was made to bring in new men who would be willing to carry their share of the work, and those eliminated felt satisfied that they had been given fair and full consideration. The training program was deemed to have served its purpose: it prepared the men to start confidently in new positions and a new atmosphere, an objective reached in much shorter time than it could have been by the on-the-job method alone.

Union Promotes Europe's Power Pool

UCPTE fosters agreements for mutual exchanges of needed power across the frontiers of eight Western countries

The Union for Coordination of the Production and Transport of Electric Power (UCPTE) promotes the coordinated operation of generating stations and transmission systems in Western Europe. In doing this, the Union strives for the best use of facilities now operating or yet to be created. It assumed this task upon its establishment in May 1951 by the Organization for European Economic Cooperation (OEEC).

An independent body, UCPTE brings together representatives of the large power generating and distributing companies of Western European countries—Austria, Belgium, the Federal Republic of Germany, France, Italy, Luxembourg, the Netherlands, and Switzerland. These companies operate over interconnections, or intend to operate in this way. Each national delegation includes a government representative.

UCPTE has gained steadily in influence during the past seven years. International organizations, both private and governmental, consult it on problems of power supply and often accord their own help.

Today's power supply companies must be able to count on neighboring companies for assistance in operational disturbances caused by technical failures or extraordinary meteorological conditions. Assurance of such help provides the atmosphere congenial for the operation of an interconnected system. The Union encourages such a system by promoting short-term power interchanges which, generally, are of an occasional nature.

Its 1955-56 meetings suggest how it operates. In that year, the Union met in Paris, Amsterdam, and Montreux, each full conclave being preceded by an assembly of the Steering Committee—in Venice, Basle, and Paris, respectively. It prepares a simple diagram of Europe's interconnected lines and compiles data on power exchange among various countries. These provide power-company members with information not hitherto available. The diagram is a standard feature of UCPTE's annual report. Other data it disseminates relate to the following:

1. Actual power interchange during a period of two weeks, maximum hourly interchanged power, continuity of delivery, and the direction of power exchanges.

2. Monthly data on water overflow loss due to lack of consumption in a particular country.

3. Monthly forecasts of the increase in power imports and exports over and above those specified in base contracts.

Such information has proved especially useful for countries having thermal power solely, such as Belgium, the Netherlands, and, to a certain degree, the Federal Republic of Germany.

Obtains Liberalization

Information on exchange possibilities had little practicality, however, until UCPTE had obtained an easing of the delivery conditions for short-term power interchanges. For this, it applied to OEEC. Today, international authorization of power imports and exports within generous quotas is given in advance. The authorization includes the allocation of funds for foreign exchange.

The liberalization was obtained in mid 1953. It made possible the incorporation of provisions in long-term delivery contracts for occasional power supplies sometimes limited to a few hours. A telephone call today can obtain permission for a company to accept delivery within the next hour.

Since UCPTE's inauguration, power interchanges among member countries rose from 1950's 2,783 million kwhr to 5,030 million kwhr in 1955, an increase of 81%. But the increase in power consumption in the countries averaged only 57%.

Results achieved through short-term power interchanges can be illustrated by example. Countries with predominantly hydro generation have supplied substantial quantities of power during summer peak hours. Austria on several occasions exported up to 50% of its generation; Switzerland, up to 15%. In the winter of 1955-56, Switzerland suffered a pronounced power shortage which was mitigated by short-term deliveries in addition to supplies on the basis of long-term contracts. Deliveries of thermal power from France, Germany, Belgium, and Italy on certain days allowed an almost 20% coverage of the Swiss demand. Towards the end of the same winter, Italy took considerable amounts of stopgap power from various UCPTE countries.

Long-term power deliveries do not fall within the scope of UCPTE activities. Yet the Union has not neglected such a significant segment of power exchange. At any rate, the distinguishing line between short-term and long-term deliveries is not clearcut, and the same installations serve both kinds of exchange.

The Union exerted favorable influence on the arrangements between Switzerland and her neighbors. These, in the absence of the actual contracts, would have been considered short-term transactions, such, in fact, being the basis of the agreement. In general, the agreements, pertaining to seasonal exchanges, could be classified as ranging between the accords on short-term and long-term exchanges.

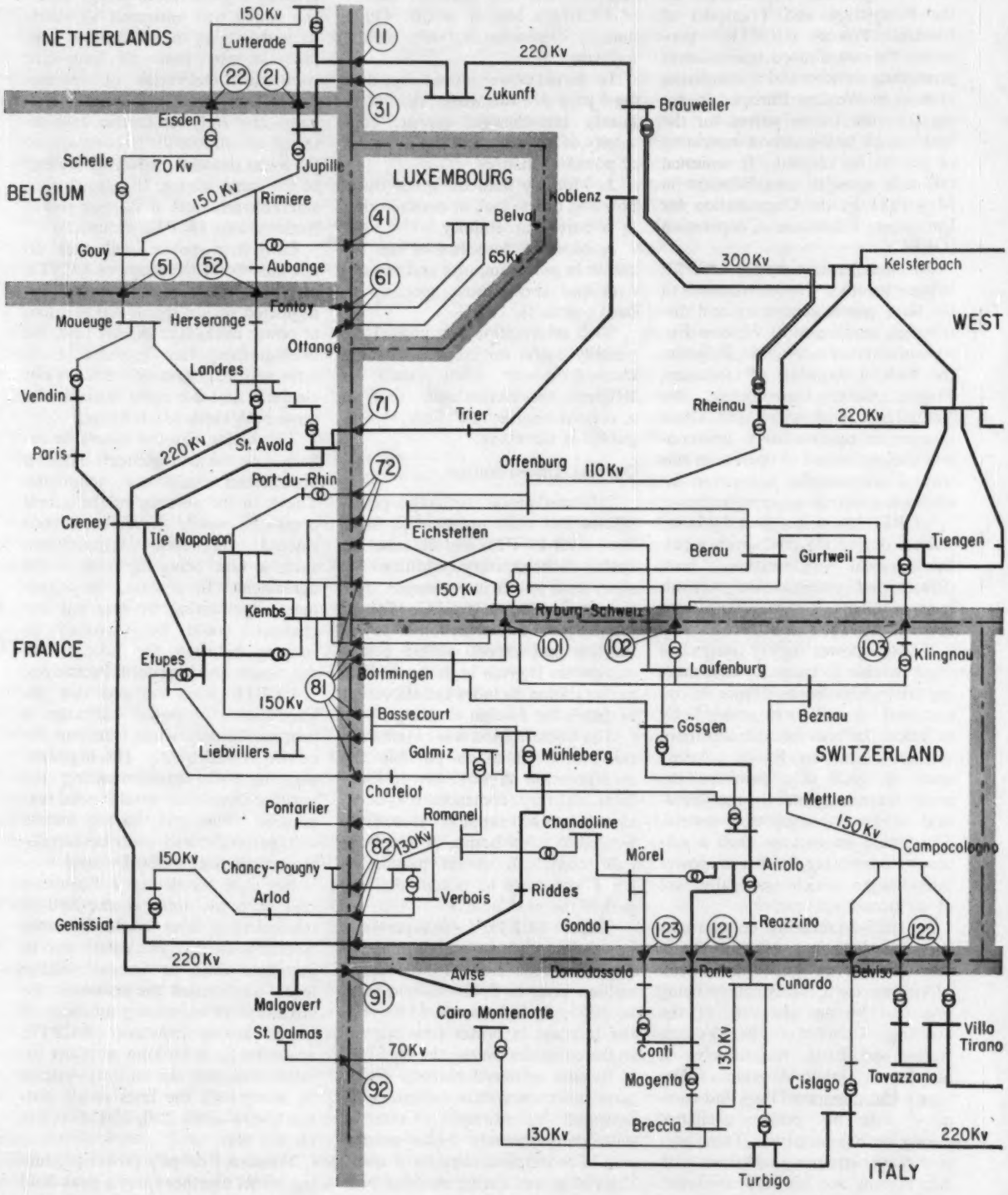
UCPTE soon realized that intensification of power exchange is practicable only when transport facilities are adequate. The high-tension network interconnecting the various countries would need expansion. This grid, having several voltage levels, will soon be supplemented by a new 380-kv level.

No plan restricting a European grid to power lines at the 380-kv transmission level could be considered realistic. The entire web of interstate lines at various voltage levels implements the economic interchange of increasing amounts of power across frontiers. UCPTE, accordingly, is looking at plans for interconnecting the various systems by using fully the lines at all voltage levels—380, 220, 150, 110, 90, 60 kv, etc.

Western Europe's power-producing plants together carry a peak load

between 30 million and 35 million kw. The corresponding capacity is supplied by thermal or hydro plants in a proportion almost the same for all countries combined, the percentages of thermal or hydro power covering peaks fluctuating with the water flow. The conditions and time for overhauling thermal plant are of capital importance for the effective operation of the entire power pool. Overhauls must be carried out and completed after the winter and before the beginning of autumn, so that the thermal stations will be ready for operation when river water is low.

UCPTE has created a special task force, consisting of members of



the Union and thermal power experts of the different countries, to prepare a coordinated plan for thermal plant overhaul and to assure the most economic operation of such installations. This group has initiated a general survey of operating failures in thermal generating stations of all member countries. On the basis of this group's experience, an overhaul program is set up each year to be carried out under the most favorable circumstances. In fact, the regular preparation by all interested countries of a coordinated plan for the operation and overhaul of thermal plants may be considered one of the most important accomplishments of the UCPTE. Effective execution of the program has minimized water losses.

Experts on regulation have met frequently as a UCPTE task force to discuss the standardization of regulating equipment in the several countries. Since 1957, most countries can go to parallel operation through application of frequency-power regulation or its variant, phase-energy regulation. Networks operating in parallel have an overall capacity of about 30 million kw. The Western European systems have operated in parallel several times, one partner assuming frequency regulation and the others controlling interchange power at the border transfer points. Combined capacity of networks thus operated has already amounted to 25 million kw.

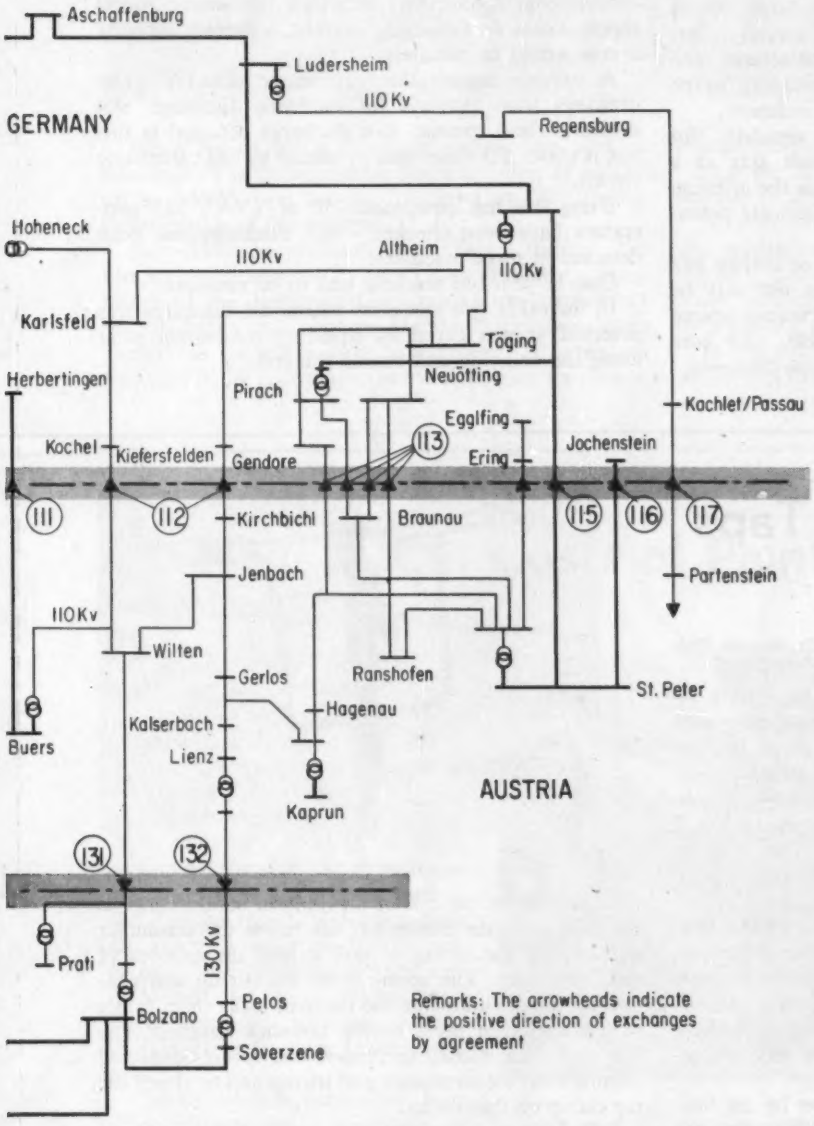
It is planned to ring-connect the various systems to assure continuity of supply in the event that the ring is ruptured at any point. UCPTE is studying the conditions for implementing this operating technique. It is also working out a method for evaluating deviations between the interchange program and the recorded physical exchange, such deviations being traceable to imperfection of the regulating equipment in use. Such a procedure will facilitate international pool operations.

Since 1954 associate members have been invited to attend meetings of the Union together with the founder members. Associate members are chosen from among the most competent power experts of each participating country. They have furthered the Union's work by contributing valuable information.

The setting up of task forces, especially those for the overhaul of thermal power, operational problems, and the establishment of hydraulicity indices, has permitted plant engineers to become acquainted with UCPTE objectives, to take part in its activities, and to pass on the practical experiences gained.

Since 1955 UCPTE has issued a quarterly report which has proved effective in publicizing the joint work accomplished by the members. The report is in five languages.

SCHEMATIC OF INTERCONNECTIONS shows the electrical linkages among the eight countries of western Europe represented in the Union for Coordination of the Production and Transport of Electric Power. National transmission lines are operated at a variety of voltage levels from 60 to 380 kv, yet all have been brought into the comprehensive grid through which, in an emergency, neighboring countries can assist a national system in meeting occasional power deficits



Slot Discharge Detector Cuts Repair Costs

CLIFFORD A. DUKE, Chief, Electrical Lab & Test Branch, Tennessee Valley Authority, Chattanooga, Tenn.

A tester for detecting slot discharge and corona in generators has been developed by Tennessee Valley Authority. Use of the tester permits early location of damaged insulation, reducing cost of repairs, eliminating unforeseen outages, and improving service.

Arcing and corona radiate energy, superimposing upon the coil a very small voltage with strong components at frequencies of about 2,000 cycles.

To detect this in the presence of a large 60-cps phase-to-ground voltage, TVA built a special tester. It is based on previous work by a manufacturer, and requires only connections to ground, winding to be tested, and the oscilloscope used as an indicator.

In the detector, a calibrating circuit simulates slot discharge on one coil side. This circuit acts as a reference against which slot discharge in the winding under test is compared. A voltmeter to indicate potential of the winding is in the detector.

Any voltage source free of ionization or corona and capable of energizing the winding under test may be used. However, TVA developed a novel voltage source that is continuously variable and portable. Air core reactors are connected in series with the test supply and the winding to be tested. Series resonance of the reactors with the winding capacitance produces the required voltage to ground from a comparatively low-capacity, easily-controlled source.

The source with exact resonance would supply only the losses in the equipment. In practice, exact resonance is not achieved, as it would require a fine adjustment of the reactor inductances. But near resonance is obtained to permit use of a 5-kva source. With conventional connections in which the source would supply losses and charging current, a greater capacity source would be required.

A camera records the oscilloscope displays. The drawings show displays for reference discharge, slot discharge, and corona. Slot discharge detected in this test is about 1.5 times that produced by the calibrating circuit.

Using this test equipment, 50 of TVA's 187 generators have been checked. Slot discharge has been detected in three machines.

One 12-year-old machine had to be rewound.

In the other two machines where slot discharge was detected, it was cured by squirting conductive paint along the coil side and behind the coil.

Adapted from a paper presented at the 1958 Doble Conference

Stirrup Aids Hot Taps

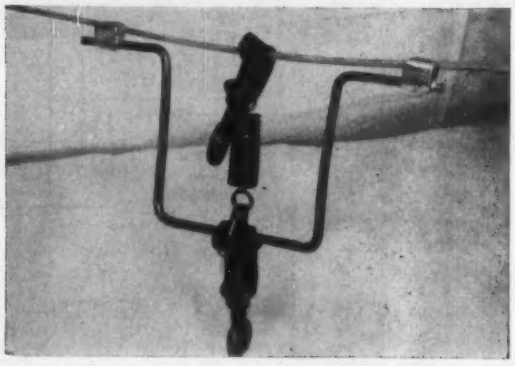
R. I. BRADEN, Lineman 1C
DONALD HUNTER, Groundman A, Ohio Power Co, Newark, Ohio

Stirrups for attaching line taps can be readily installed on hot lines by a single lineman working with a hot stick. Formerly, two linemen, more hot-line equipment, and double the time were required.

The new stirrup, used to prevent burndown of conductors if taps loosen, is made from 20 in. of No. 2 bare copper and crimped connectors. The ¾ x2-in. coiled spring between clamps holds the stirrup in position until the connectors are crimped.

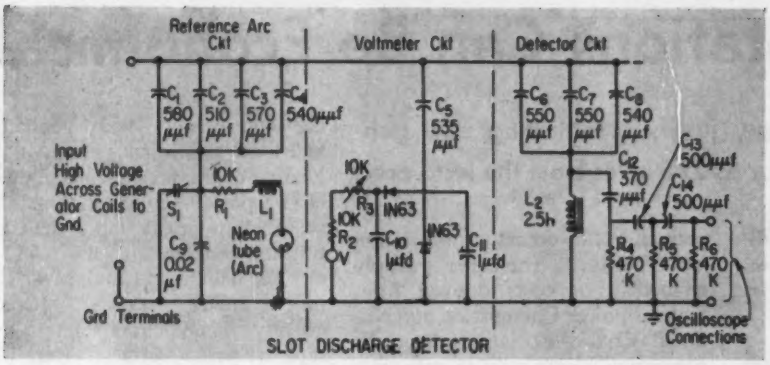
Before the winged stirrup is delivered to the lineman, a groundman slightly compresses the connectors on the wings with a hydraulic press and fastens one of the two spring-connected hot-line clamps to the lower bar of the stirrup in a vertical position. These clamps are used only during installation and are removed for re-use.

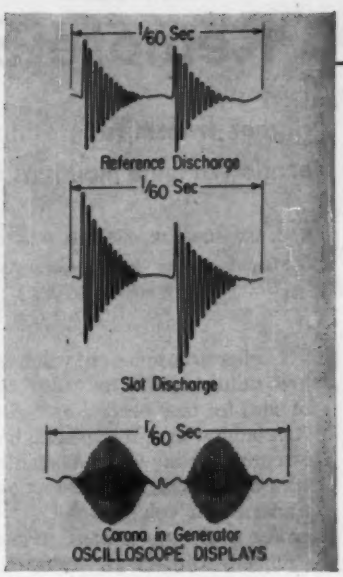
The stirrup is received in this condition by the lineman, who uses a hot stick to hang and tighten the spring-connected clamp on the conductor. Then he



pulls downs on the eye of the bottom clamp with his hot stick until the connectors are below the conductor and utilizes the spring to pull it into the grooves of the connectors. The spring holds the stirrup and connectors in position while the lineman locks them firmly with a hydraulic press having hot-stick handles. The hot stick then is used to remove the spring-connected clamps from the conductor and stirrup and to attach the tap clamp on the stirrup.

Initial cost of the stirrup is about 61¢, compared with $1.24 to $1.57 for commercial stirrups.





When testing for slot voltage, corona can also be detected. The distinguishing characteristics, as viewed on the oscilloscope, are the frequency and the change in magnitude of the voltage.

Slot discharge produces a 2,000-cps display that usually begins about 4 kv on 13.8-kv machines. Magnitude of the display voltage depends on intensity of the discharge and remains essentially constant, once started, as the test voltage is increased. Corona, on the other hand, is displayed at a much higher frequency, and the magnitude increases with test voltage.

In some of the machines where corona was found, removal of dirt on the windings eliminated it.

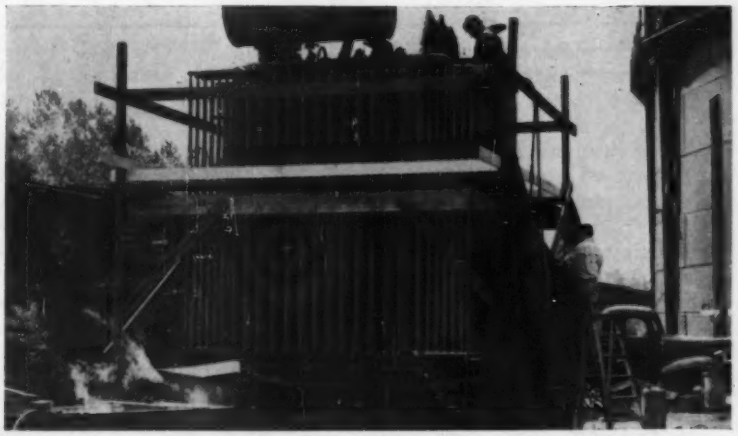
Another condition detected, similar to slot discharge, was separation of the conductive coating just outside the slot, caused by tape separation. Most of these cases were cured easily by applying either conductive or insulating paint.

In the future, all TVA generators will be checked in this way every four years or as the opportunity arises.

How to Cut Costs of Painting Transformers

The tedious, time-consuming job of painting power transformers can be simplified with savings in time, labor, material, and costs. The scheme described here is used in the Eastern Division of Niagara Mohawk Power Corp.

A temporary scaffold is built around the transformer; all bushings are covered with rubber sheeting, and dials are taped. Metal drip pans are arranged under the transformer to catch the solutions so they can be re-used. An electrically operated pump keeps the solutions flowing through hoses from the tanks to the nozzle.



Caustic solution, neutralizer, lead oxide primer, and a final coat of standard blue-gray paint are successively applied to the transformer. In each case the surplus liquid is collected in the trays, pumped out, and re-used. Portable kerosene heaters heat the caustic solution and the neutralizer to the 180F required for application.

Remote Stations Can Be Economically

Higher transmission voltages justify establishing new generation at mine mouth as far as 275 miles from the load area

H. C. SIMMONS JR, and R. D. DARTNALL,
Electric Utility Engineering, General Electric Co, Schenectady, N. Y.

Higher transmission voltages allow utilities today a wider choice of sites for new generating facilities. Remote low-cost-fuel plants, having essential cooling water available, increase in economic attraction as transmission voltages and the bulk power to be transmitted go higher. Coupled with high transmission load factors, these favor plant location at the mine mouth by giving such plants a cost edge over stations whose proximity to load centers necessitates fuel importation.

Rail Costs Representative

As means of energy transportation, electrical transmission at various transmission load factors for distances up to about 350 miles is compared in Fig 1 with coal shipped by rail or barge, and gas and oil by pipeline.

The curve showing the cost of transporting coal by rail is "representative." Actually these costs vary widely for any given distance, depending upon geography and competition with other transportation and other fuels. The curve is simply a median of costs derived from Federal Power Commission and National Coal Association data. In converting freight rates to mills-per-kwhr, a plant heat rate of 9,100 Btu per kwhr is assumed. Improved economies with higher-pressure-and-temperature machines would reduce these rates on a mills-per-kwhr basis.

The transmission-cost curves are plotted for load factors of 60, 70, 80, and 90%. The costs include sending and receiving-end transformers and switchgear, line and moderate rights-of-way costs, intermediate switching stations, series capacitor compensation, where required, capacity and energy losses, and reactive supply requirements. Single-circuit, steel-tower line construction was assumed, single conductor for 230 kv and less, and dual conductors of sufficient diameter for acceptable radio-interference levels for 345 kv and above. All power is delivered to a 138-kv receiving system.

Transmission costs in Fig 1 are also "representative" costs. Installed line costs for example, varying considerably with geography and local conditions. For economy loading at the higher voltages, very large power concentrations are required to justify more than two transmission circuits. Two 460-kv circuits handle a 1,600 Mw, 200-mile power transfer. Consequently, single-circuit lines over separate rights-of-way were assumed, and no cost advantage was taken for double-circuit towers.

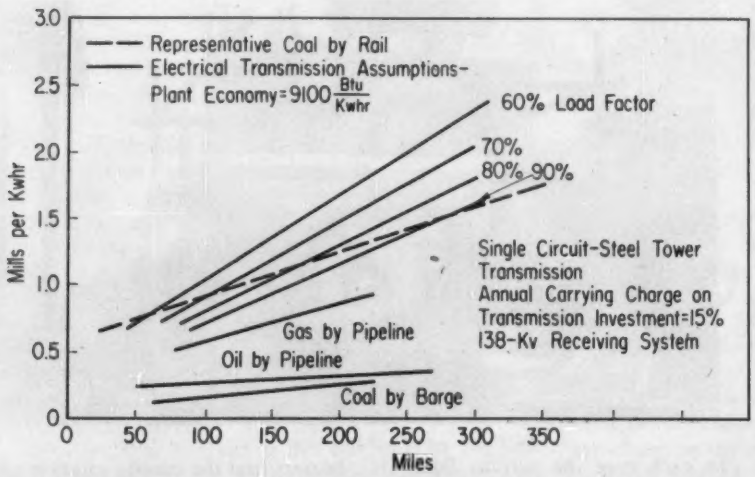


FIG 1—ENERGY TRANSPORTATION as coal by rail or barge, gas and oil by pipeline compared with electrical transmission at load factors up to 350 miles

Carrying Charge Applied

A 15% annual carrying charge was applied to the transmission investment in determining mills-per-kwhr costs. The curves reflect optimum circuit loadings and transmission voltage levels for each distance, circuit loadings for 100 miles and more being limited primarily by stability considerations.

Accordingly, the points at the intersections of the coal-transportation curve with the various transmission curves show that power transmission for about 170 miles is economically feasible at an 80% load factor. At 90% load factor savings in favor of electrical transmission are possible for distances up to 280 miles.

As transmission distances increase, only higher voltage and circuit loadings bring economies. In Fig 2, Curves A, B, and C indicate 90% load-factor costs for 230, 345, and 460 kv transmission between 100 and 300 miles. Minimum circuit loading requirements for obtaining costs of a 200-mile transmission system are indicated. At 200 miles, 230-kv transmission doesn't compete with coal-by-freight costs, but 345 and 460-kv transmission does compete for large blocks of power transfer. A two-circuit, firm-power system realizes its indicated transmission costs when 900 Mw is transferred at 345 kv and 1,600 Mw at 460 kv.

As generating stations of such size will usually take a number of years to develop, "time-to-full-utilization" of transmission facilities is economically important. In Fig 2, a 450-Mw size was assumed for an initial station in a low-cost-fuel region. Station growth was assumed

Operated

to take place in steps of a 450-Mw block of new generation every five years until the station's capacity reached 1,800 Mw. At this point, a 30-year present-worth comparison of two-circuit 345-kv transmission with the cost of shipping coal by rail shows a 3% savings for the latter. But faster growth rates reduce and ultimately reverse this differential. An initial 900-Mw station could fully load two 345-kv circuits, and the savings in transporting energy would then favor transmission by about 6%.

A single transmission channel from a low-cost-fuel region may be feasible in early years of operation if spinning reserve in the receiving system is enough to assure system reliability. In such circumstances, the time-to-full-utilization factor, which appreciably handicaps higher transmission voltages in the normal "two-circuit" minimum concept, becomes small or even negligible. Under this operational philosophy, a 450-Mw plant could be operated at 345-kv transmission and at a 6% saving over shipping coal.

Actually, obtaining a 90% transmission load factor, with a receiving-system load factor in the order of 60%, is practicable only so long as the low-cost-fuel generation supplies a relatively small portion of the receiving system load. A typical system load-duration curve indicates that about 30% of total system generation can be base loaded.

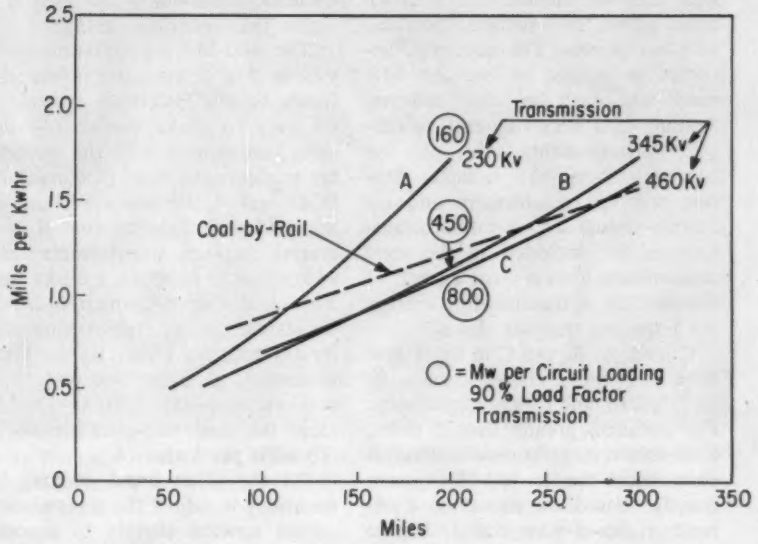


FIG 2—HIGHER TRANSMISSION VOLTAGES and higher circuit loading are needed so minimum transmission costs can be realized for longer transmission

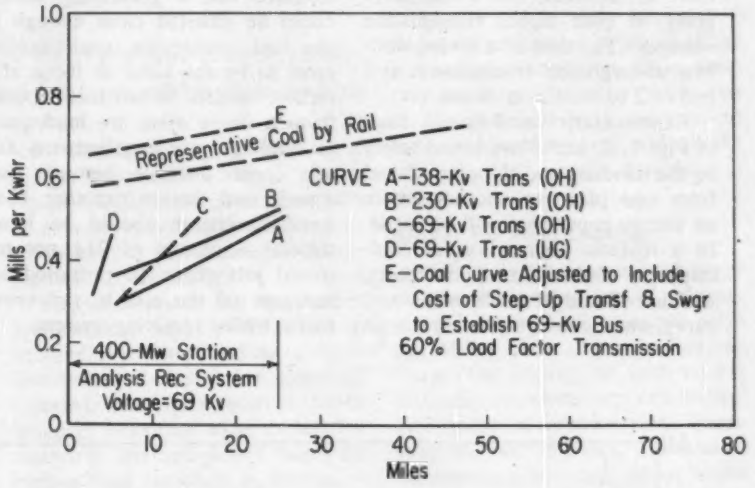


FIG 3—ENERGY TRANSPORTATION ECONOMICS explored for coal by rail and electric transmission at short distances at which terminal costs are large

Allow 90% Load Factor

Assuming machine down-time for forced outages and planned maintenance, 30% generation in the low-cost-fuel region would allow a transmission load factor of about 90%. Obviously, were total system generation in the low-cost-fuel region, the transmission load factor would be the same as that of the system, i.e., 60%. Fig 1 shows that at 200 miles, minimum-cost transmission doesn't compete with coal by rail once the transmission load factor drops below about 83%.

Fig 1 also contains the cost of transporting gas and oil by pipeline. Over a fixed distance, pipelines transport energy more cheaply than electrical transmission. But there are other factors. The source of natural gas is concentrated in about five Southwestern states. There and for a few hundred miles around, gas by pipeline is more economical. Outside that area the problem becomes a comparision of coal or electrical transmission at 200 or 300 vs gas transmitted 500 or 600 miles.

But, in considering coal, oil, and gas, the cost of transporting energy is not the only prerequisite. The initial cost of these various fuels must be factored into a comparison of energy sources. And an adequate year-around supply for many years of a selected fuel must be assured at prices not subject to sharp fluctuations.

Fig 3 explores the economics of transportation of coal by rail and electrical transmission over shorter distances. Representative coal-by-rail costs were taken from Fig 1. Of particular interest are the distances shorter than 25 miles where terminal equipment costs constitute a higher percentage of the total transmission system costs.

A study of transmitting the output of a 400-Mw plant to a 69-kv

load area for distances of 5 to 25 miles serves to illustrate some interesting points. The station is assumed to consist of two 200-Mw machines, each in unit scheme. Sending and receiving-end switchgear arrangements are of the breaker-and-one-half scheme. Station step-up transformers and receiving-system step-down autotransformers are included in the total transmission system costs except, of course, for a transmission voltage not requiring stepping down.

Curves A, B, and C in Fig 3 give 60% load factor transmission costs at 138, 230, and 69 kv, respectively. For distances greater than 5 miles, a double-voltage transformation is economical for a 400-Mw power transfer based on moderate overhead rights-of-way costs. Higher rights-of-way, seemingly inherent in shorter distances, would not only make the double transformation more economical, but would favor going to even higher transmission voltages. The cost of a 69-kv, 400-Mw underground transmission system of 2 to 5 miles is shown.

Representative coal-by-rail costs in Figs 1, 2, and 3 are based solely on the handling and shipping of coal from one place to another where an energy conversion will be made. In a realistic comparison of coal-shipment and transmission costs, addition should be made to the coal curve when converted energy is to be made available to the load at a higher than generator voltage.

The 400-Mw transmission analysis in Fig 3 assumed power delivery to the receiving system at 69 kv. To make the coal-by-rail costs comparable with the particular transmission costs of Curves A, B, C, and D, the coal curve can be adjusted to include the cost of generator step-up transformers and switchgear to establish a 69-kv bus. This yields Curve E which, in effect, boosts the cost of transporting coal by .08 mills per kwhr. By the same reasoning, a higher receiving system voltage—say 230 kv—would raise the coal transporation curve .13 mills per kwhr.

On the other hand, it may be necessary to adjust the transmission curves upward slightly to account for the handling of coal between the mine mouth and a low-cost-fuel-area station. Up to now it has been assumed that a generating station could be situated close enough to the fuel source for coal-handling costs to be the same as those at a remote station. When fuel supplies from a single mine are inadequate or cooling-water requirements dictate some distance between fuel source and station, another coal-handling charge should be introduced. A charge of 21¢ per ton would just offset the proposed adjustment of the coal-by-rail curve for a 69-kv receiving system.

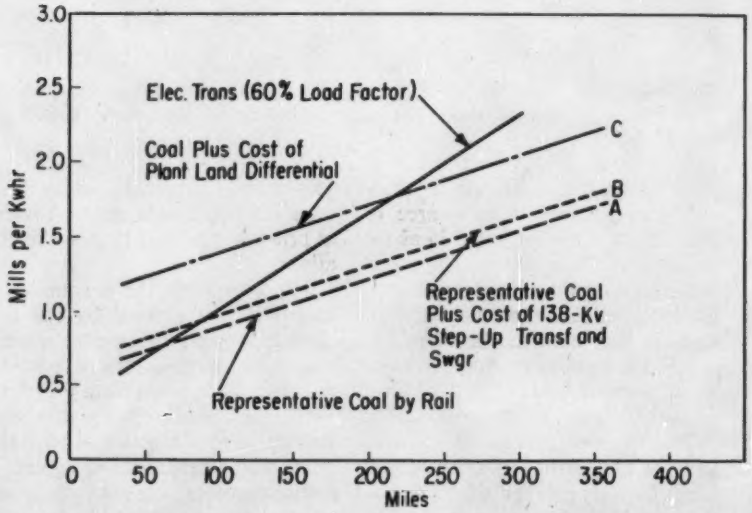


FIG 4—BREAK-EVEN DISTANCE is shown to be 215 rather than 60 miles at 60% load factor, site costs tending to justify longer transmission at 60% load factor

The transmission (60% load factor) and the representative coal-by-rail curves of Fig 1 are also in Fig 4. Fig 4's Curve A is adjusted upward to account for the step-up transformers and switchgear for delivering power to a 138-kv system.

Heretofore it was assumed that land on which the generating station is built would cost the same whether in a load area or at the mine. As it is becoming more difficult to obtain suitable sites near large metropolitan load areas, a land cost differential between a load-area plant and a remote one will often be a factor. "Cost of Performance Data of 44 Modern Steam Stations," (EW, Oct 7, 1957, p 122) gives generating station land costs ranging from 0.15 to 15.01 dollars per kw. At a plant load factor of 60% and with an annual carrying charge of 15%, the maximum differential in land cost amounts to 0.4 mills per kwhr. The high cost of land in a load area, an additional expense when coal is hauled by rail to a metropolitan plant, can be treated as an adjustment to the coal-by-rail cost curve.

The cost of step-up transformers and switchgear and the land-price differential can both be thought of as effectively increasing the cost of coal by rail, tending to make electrical transmission economical at longer distances. Fig 4 indicates a break-even distance of 215 miles.

Furthermore, suitable load-area sites are sometimes unobtainable at any price, and a new station can readily require 50 miles of transmission. On this basis the adjustment against the coal-by-rail charge adds 0.7 mills per kwhr to Fig 4's Curve A. Then nearly 300-mile transmission is justified even at 60% load factor.

It is too early to draw any final economic conclusions about transportation of coal by pipeline, although it is now a reality. Initial estimates indicate that where rail costs are above average, the coal pipeline may reduce transportation charges to average coal-by-rail costs. But merely reducing transportation costs to the coal-by-rail cost is not enough to obtain the lowest transportation-of-energy cost. For the movement of large blocks of power at reasonably high load factors, electrical transmission appears to be the economic instrument.

SPEAKERS at transmission session were: G. H. Phillips, Alcoa; H. B. Balfour, Louisiana P&L; George Barney, Stone & Webster. Phillips spoke on problems of creep in ACSR T. J. Allen, Georgia Power; P. S. Colby, Carolina P&L;

Cites 'Most Promising' Reactor

SEE speaker tells advantages of heavy-water power reactor: Phase-angle meter advocated for use on transmission line

Most promising nuclear reactor is the pressure-tube, heavy-water moderated and cooled design, E. C. Fiss, Carolinas Virginia Nuclear Power Associates, recently told the Engineering & Operating Section, Southeastern Electric Exchange, at Biloxi, Miss. This design offers these advantages:

1. No size limitation.
2. Easy refueling.
3. Eliminates the problems of penetrating a high-pressure vessel because control rods operate in moderator at atmospheric pressure.
4. Easy location of failed fuel elements.
5. More efficient use of fissionable materials.
6. Improved neutron economy through use of heavy water for coolant and moderator.
7. Permits use of natural uranium in larger sizes.

A new trend in load dispatching techniques may be available through the use of an instrument that measures phase-angle conditions on live high-voltage transmission lines, said Frank C. Doble, Doble Engineering Co. This instrument connects to a capacitor or to a bushing having a capacitor tap and can measure and duplicate phase angle in terms of a few minutes of angle. Because a change in power flow always follows a phase shift, readings of the shifts at remote system points can give the dispatcher useful data for directing flow economically.

This instrument has two other applications, said Doble. It can be used as a better and more accurate potential device for metering, relaying, etc. In insulation maintenance, it can be used to test for dielectric loss and power factor on high-voltage bushings in service.

Scores Reductions

"The greatest disaster ever to befall our industry" could be a "drive to cut the cost of electrical equipment and apparatus to the point where research and development must suffer," said P. T. Lagrone, Westinghouse Electric Corp. Although the drive might produce immediate savings, it would bring long-range losses. Utilities would not get improved quality and lowered real costs. Manufacturers would be living off the diminishing research "fat." Such a drive would pull from under the public the "magic carpet" that has increased the standard of living. But the public would have an answer: it could ask government to take over another segment of the free enterprise system. For these reasons, Lagrone said, "your continued partnership is essential to our continued research and all the improvements and benefits it brings."

Argues for Fleet Leasing

Numerous advantages and arguments against objections of net leasing of vehicle fleets were put forth by Alvin Zises, Bankers Leasing Corp. Net leasing, he said, covers primarily the ownership and capital investment in vehicles. The lessee supplies all repairs, insurance, maintenance, garaging, etc, as would be necessary with a company-owned fleet. Thus, net leasing provides utilities with financial benefits by releasing capital and deferring financing. Operational advantages result through simplifying replacement of older equipment with labor-saving equipment, permitting retirement of high-maintenance cost units, and reducing acquisition costs.

Series capacitors in a long 13.8-kv distribution line has proved economical for reducing voltage flicker caused by motors for cotton ginning, said Jack Davey, Louisiana Power & Light Co. The installation costing $4,710 has a 450-kvar, 3-phase bank in series with reclosers in the line, bypass and sectionalizing switches, and a transformer to sup-

ply control power. Paralleling the capacitors in each phase are an overvoltage protective gap and an electrically operated oil switch which protects against resonance.

The oil switch is set to short the bank 10 sec after voltage is re-established following an outage. It remains closed for a short time and then opens. Control of this switch is connected to a CT in the gap circuit to short the gap and extinguish an arc when the gap doesn't clear itself. Thus far, the gaps have proved self-clearing.

The shorting gap is set to fire at 250% voltage, said Davey. Smaller over-voltages are handled by the reclosers.

After presenting the report on the laboratory investigations into aluminum connections (EW, March 31, p 38), Frank E. Sanford, Commonwealth Associates Inc. said that connectors should be considered as a piece of equipment, rather than as hardware, and evaluated and purchased in relation to operating conditions. Possibly two or three levels of ratings are needed for different performance requirements, he said.

But F. G. Hamner, Southern Services, Inc, said that several grades of connectors for different duty conditions would present a stocking problem. M. L. Cathey, Georgia Power Co, cited the problem of identifying grades.

Cites Accounting Benefits

A new minor materials system provides monetary as well as morale, time, and accounting benefits to Georgia Power Co, said Orbie M. Campbell. The system is applied to overhead work—except job orders—and covers selected items up to $4.37. Basic elements are:

1. Minor materials are supplied to districts through the general warehouse where records are kept.

2. Districts are charged with the value of minor materials given to crews without accounting.

3. The accounting department charges the value of minor materials to appropriate accounts and credits the districts, using a loading factor applied to major items.

The loading factor consists of the weighted average quantity of each minor material item normally used with a major item, said Campbell. Dollar value of the loading is computed by using the latest prices to assure accurate plant accounts.

New methods of working on hot 12-kv lines are being tried by Florida Power Corp, said Herbert B. McMahan. First step is to offer linemen the possibility of working in proximity to, not on, 12 kv using new corona resistant coverings. With union approval, several crews will be selected, and they can choose 15 or 20-kv gloves. They will work for six months in proximity to 7.2-kv primary. Should this prove successful, the crews will start using 5-ft insulating boards and working on the hot primary.

A single-sleeve splice, simple to install on ACSR, has been developed by Burndy Corp, said James J. Hennessy. This splice is filled with a special compound that grips the steel core and aluminum strands, breaks down the oxide film, and seals the joint against corrosion. It meets EEI proposed performance standards for use on Bethanized and aluminized core ACSR, Kaiser AAAC alloy conductor, and Reynolds 5005 alloy conductor. The sleeve is not recommended for greased-core ACSR as yet, unless the strands are previously splayed and the grease removed.

Increased loading of lines and associated higher conductor temperatures can cause creep problems with aluminum, said G. H. Phillips, Alcoa. Dangerous values of creep, resulting in greater sag, may occur in all-aluminum and other single-metal conductors. But creep in ACSR is very small as temperature increases as mechanical stress shifts from aluminum strands to the steel core.

Creep Is Studied

The effects of heat on all-aluminum conductor creep are being studied, continued Phillips. These tests "may eventually result in the use of creep data at some temperature higher than room temperature in making sag-tension calculations."

Experience in sagging large-size all-aluminum conductors indicates that conductor temperature should be used rather than ambient temperature. "There is quite a difference between the two", said N. C. Spencer, Gulf States Utilities Co. The large mass of all-aluminum absorbs and stores heat, and its temperature lags behind ambient changes. Thus, GSU's practice is to use temperature read on a thermometer taped to a piece of the same wire at the sagging location.

Experience also indicates, continued Spencer, that "partial pre-stretch initial" sagging reduces creep when the line is too long to be sagged at one time. This method for 1,033.5 MCM AA applies 7,300-lb pull for 30 min before sagging.

Sulphur hexafluoride interrupter switches costing about 67 cents per kva are the most economical method of switching 10,000-kvar capacitor banks at 115 kv. Hugh B. Balfour, Louisiana Power & Light Co, based this assertion on 2½-years' experience with an SF_6 interrupter and several months with another. The vacuum tube interrupter could prove as economical for similar capacitor banks, Balfour continued, but LP&L has had only 6 months' experience with the vacuum device.

Bus Arrangements Analyzed

After analyzing the features of numerous switching arrangements for high-voltage buses at generating stations, George Barney, Stone & Webster Engineering Corp, concluded that:

1. Circuit breakers generally dictate the selection of the switching scheme because they are a large part of the cost.

2. Arrangements of two circuits per bay are less costly than one circuit per bay because the main buses are shorter and some structures common to the two circuits.

3. Rigid buses cost more than strain buses.

4. But maintenance of rigid buses costs less, particularly if the strain buses are multilevel.

5. Low-level designs utilize individual structures for most equipment permitting standardization and repetitive manufacture, which tends to offset the higher foundation costs.

In discussion, Harry Street said that Florida Power & Light Co generally uses breaker-and-a-half schemes for generating substations. Operators like the scheme, but it has a limitation when small generators are connected through it to a large-capacity system. The breakers must be of adequate size.

Bus Scheme Described

Georgia Power Co's practice for generating substations is to install a scheme having a double main bus

and a common transfer bus, said F. E. Brown. Only one ring bus arrangement has been installed.

The new ASA wind-loading standards, if adopted, would require much stronger structures than the present NESC requires, said M. W. Stumpf. For example, in the New Orleans Public Service Inc's area the wind loadings in lb per sq ft for round, flat, and trussed surfaces would be increased three to four times at the 30-ft height.

Florida Power & Light Co is designing for 50 lb per sq ft, equivalent to about 142-mph wind, said Harry Street. Poles are side guyed on 300-ft spans. When guys cannot be installed, spans are shortened. Anchors are precast concrete slabs, and bog shoes are installed.

Wood-pole H-frame lines are designed by Carolina Power & Light Co with a safety factor of 3.5 based on medium loading as defined in the NESC. Fred D. Jerome said these lines have been very satisfactory.

Duke Power Co has been using high-strength structural steel for transmission structures during the past three years, said M. R. Kimbrell. Although the steel costs more per lb, the reduced weight, along with lower handling costs and greater corrosion resistance, provides a more economical tower.

Caustic Extends Tube Life

Present load and forecasts favor EHV transmission (above 230 kv) for more and more companies because of the lower cost per megawatt of capability, said Miles Maxwell, Westinghouse Electric Corp. Other factors behind the EHV trend are acquisition of rights-of-way, larger plant sizes, and the higher capacity interconnections. The latter factor is growing in importance because of benefits in addition to the normal ones of increasing the allowable unit size, cutting total required generation, and allowing economy energy exchange. Savings now receiving more consideration result from lower fuel and manpower costs with older plants on cold standby instead of spinning reserve and economy interchange from weather variations, time zones, and production costs in a large pool.

Periodic addition of waste caustic to increase the pH of circulating water prolongs the life of aluminum-brass and cupro-nickle condenser tubes under very adverse conditions, reported W. B. Gurney, Gulf States Utilities Co. The raising of the pH appears to lay down a film that protects the tubes from high velocity, all mixtures of sea and fresh water, high chlorides, high temperatures, and waters containing sulfide waste products.

To protect the tubes, waste caustic from the anion units of the demineralizing plant is added to the circulating water to raise the pH to over 8.3 for an hour. During this time, Gurney continued, acid from the cation units, detained in a tank, is automatically fed to the circulating water discharging from the plant. This process returns the water pH to the level of the river. Gurney said that only one side of the condenser can be treated at a time.

Advance Training Pays

The most effective method of preventing steam generator tube failures appears to be keeping tube surfaces clean. J. P. Engle and C. E. Fox, Dowell Inc, recommended a new additive for removing iron-oxide and copper deposits simultaneously in a single-stage 6-hr treatment. Removal of the deposits, he said, eliminates localized overheating of the metal, a principal cause of failure.

More than 200 units have been treated with this additive, said Engle and Fox. Close inspection of more than a dozen revealed that the copper deposits were completely removed. No tube rupture has been reported on any of the 200 units, following cleaning with the additive.

A thorough and extensive program for training personnel to operate a new coal-burning station proved beneficial, said H. A. Moshell Jr and B. D. Kitching, Tampa Electric Co. The program consisted of preparation of a complete training manual, temporary advancement of personnel in existing plants, and instruction of personnel. Production department staff and plant chief and assistant chief engineers taught the head watch engineers. They, in turn, instructed operating crews by going over material at least twice and by on-the-job study during construction.

Results of this program are difficult to evaluate in dollars, concluded Moshell and Kitching. But personnel have shown an excellent knowledge of the station and kept it on line during trying circumstances.

Biggest obstacle to the fully automatic generating station is the inertia of convention, said F. M. Rutledge, Georgia Power Co. Programs should be started now to weed out unnecessary instruments, records, and operator duties. Rutledge urged that plant personnel be freed of useless copy work and unnecessary functions. This will "give the men a feeling of supervising the operation of expensive machinery, and they will stay alert."

When designing outdoor generating stations, electric heating cable to protect against freezing should be selected carefully to eliminate troubles caused by exposure to excessive temperatures and moisture. A. J. Rossi, Ebasco Services Inc, said that the operating temperature of the cable should be as high as possible so that the cable can be installed longitudinally directly on the pipe. When the normal operating temperature of the pipe is higher than the cable rating, a layer of interposing insulation must be installed, thus boosting expense.

Works on Stored Energy

The cable, Rossi continued, should also be able to withstand moisture. Regardless of the waterproofing on the outer insulation of the pipe, moisture may soak through and cause a failure of an inadequate cable.

To evaluate properly the performance of a condenser, all variables must be considered, not just condenser absolute pressure, said R. A. Bernhardt, Allis-Chalmers Manufacturing Co. The simplest check on performance is watching the trends of absolute pressure, air leakage, steam temperature, outlet and inlet-water temperatures, terminal difference, and temperature rise.

Use of high-speed, stored-energy circuit breakers to transfer generating station auxiliaries automatically eliminates voltage dip, excessive shock to motors, and boiler instability caused by long motor recovery times, said J. J. Heagerty and E. T. McCurry, General Electric Co. These conclusions were based on a computer study of a new 5-cycle stored energy mechanism having a set of powerful springs charged either by a high-speed ½-hp motor or manually.

Solve Transmission Sag Problems-I*

FRANCIS J. HUBERT, Associate Engineer, Los Angeles Dept of Water & Power, Los Angeles, Calif.

One chart*, developed from curves fitted empirically to the catenary, is all that is necessary to find a new transmission line sag if temperature, loading or modulus of elasticity change.

Use of the single chart eliminates successive approximations, or reference to groups of charts, each for a restricted set of conditions. Tension will be mentioned briefly; it need not be known to get a solution with this chart.

A problem often occurring in line design is the awkward calculation of new sag caused by changing conditions such as temperature or loading. Difficulty arises from interdependence of the many variables on each other; changing one condition causes other factors to change.

Here the method presented is a graphical solution, taking into account changes in unstretched cable length, temperature, loading, and modulus of elasticity of both homogeneous and heterogeneous cables.

Application—Only one chart is necessary for both transmission and distribution conductors, and is applicable in the field as well as the office. It is of general use for all sag problems: Long and short spans, heavy and light loading, large and small cable, for varying temperatures, on rural and urban lines.

The calculation chart and the direct approach to the answer are new concepts of value to line design engineers with sag or stringing problems.

The chart consists of a family of curves for various values of Z using the following equation:

$$\%\sigma = \sqrt{5625 + 4\,(\%S)^2} - 75 - \frac{Z}{800}\left[\frac{1}{\%S} + \frac{\%S}{1450}\right] \quad (1)$$

This empirical equation, developed by curve fitting to the catenary, is suitable for all level span sags.

For a nonlevel span, the most practical method is to convert the nonlevel span to an equivalent level span, calculate the changes, then convert back to the nonlevel span. To facilitate the conversion, the following equations are given in which S is the sag of a horizontal span with the same horizontal component of tension and span length L as the nonlevel span.

$$X_A = \frac{L}{1 + \sqrt{\frac{S_A + h}{S_A}}} \quad (2)$$

$$X_A = \frac{L}{2}\left[1 - \frac{h}{4S}\right] \quad (3)$$

$$S_A = S\left[1 - \frac{h}{4S}\right]^2 \quad (4)$$

$$S = \frac{h}{4} + \frac{S_A}{2} + \sqrt{\frac{S_A\,(h + S_A)}{4}} \quad (5)$$

When elevation of one support is changed, it changes distance between supports and has effect of changing slack. Change in slack, in percent of span length, is:

$$\%\Delta\sigma = \frac{50}{L^2}\,[h_1^2 - h_2^2] \quad (6)$$

Where h_1 is difference in support elevations before and h_2 difference after the change. Percent $\Delta\sigma$ is the increment of slack in percent of span length. Note that slack is always the difference between unstretched cable length and the span length; thus, as defined, it does not change when elevation of one support is changed. Effective change in slack is used on the equivalent level span.

Changing temperature will change slack:

$$\%\Delta\sigma = 100\,\alpha\Delta t \quad (7)$$

Calculations to follow are not the type encountered most frequently but which give the most trouble.

The procedure is:

- Knowing sag, solve for Z
- Find slack from the chart
- Calculate new slack and new Z
- From the chart find the new sag

SYMBOLS

S = Sag for level span; vertical distance from horizontal line through support points to lowest point of cable, ft
$\%S$ = Sag in percent of span length L
S_A = Sag for nonlevel span; vertical distance from horizontal line through lower support point to lowest point of cable, ft
L = Span length; horizontal distance between supports, ft
X_A = Horizontal distance from lower support to lowest point of cable, ft
X_B = $L - X_A$
h = Difference in elevation of the two supports, ft
σ = Slack; unstretched cable length minus span length, ft
$\%\sigma$ = Slack in percent of span length L
$\Delta\sigma$ = Increment of σ, ft
$\%\Delta\sigma$ = Increment of σ, in percent of span length L
$L+\sigma+s$ = Length of stressed cable, ft (where s = stretch)
w = Cable weight or total load per unit cable length, lb per ft
A = Cross-sectional area of cable, sq in.
E = Modulus of elasticity, lb per sq in.
Z = $\dfrac{wL \times 10^6}{AE}$, dimensionless
α = Temperature coefficient of linear expansion, ft per ft per deg F
t = Temperature, deg F

*Part II with chart and examples will appear in a subsequent issue of Electrical World.

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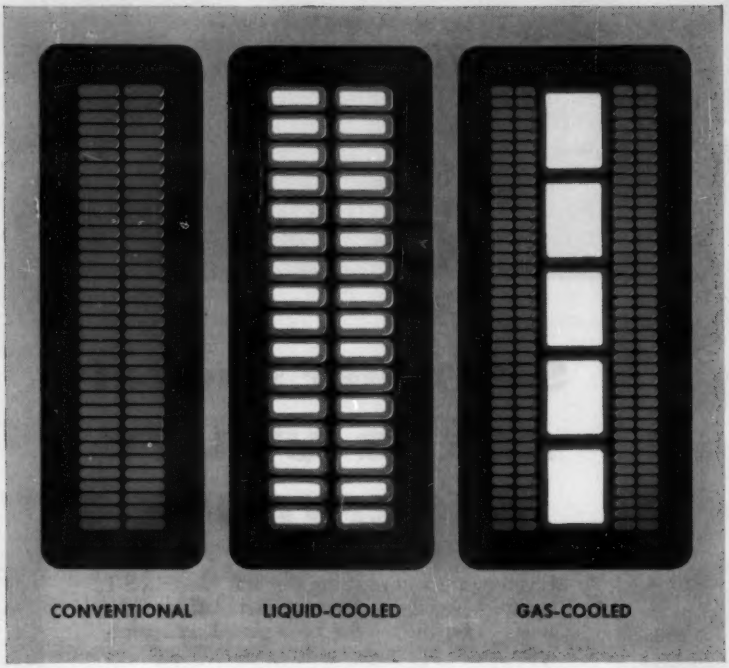
Progress Is Our Most Important Product

GENERAL ELECTRIC

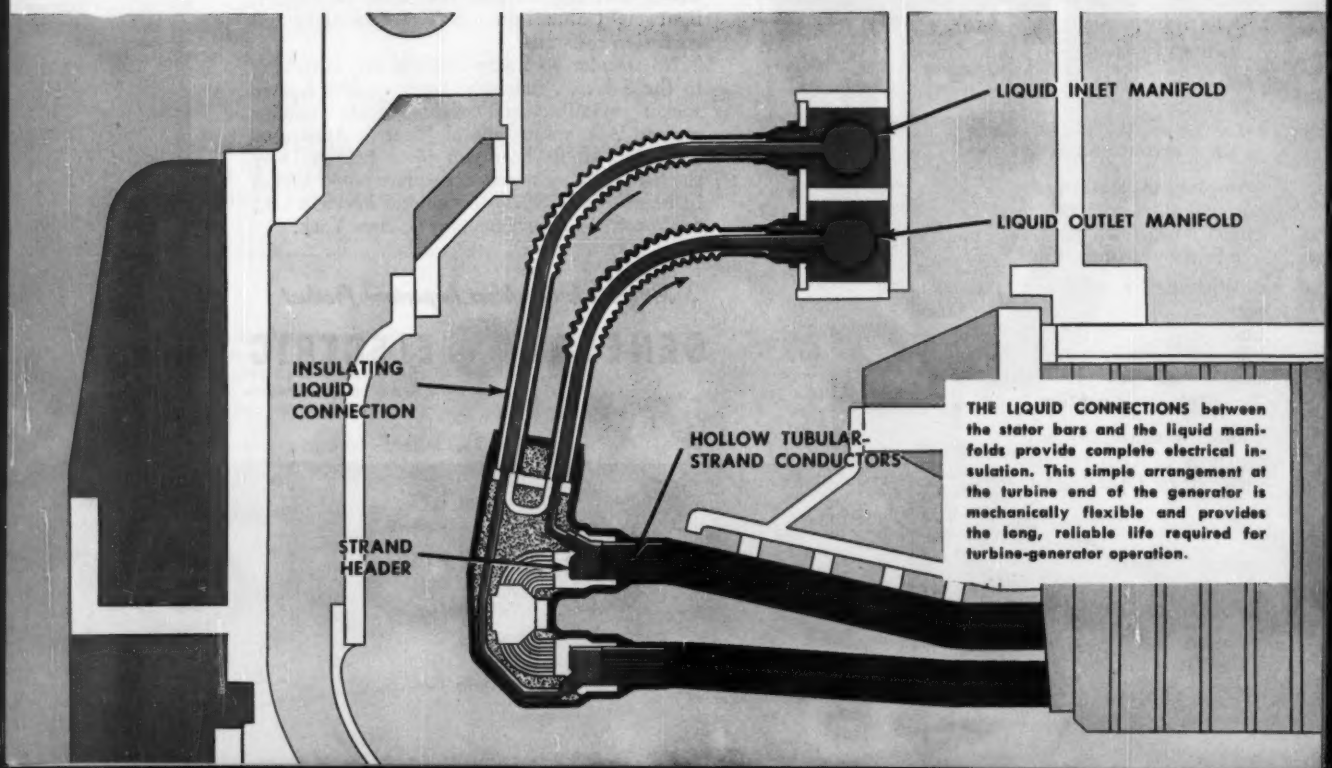


COMPARISONS of three types of stator bars built by General Electric show that dielectric construction of the liquid-cooled bar is as simple as for the conventional bar. Since liquid flows directly through the hollow conductors, no duct insulation is required as in the gas-cooled bar, and heat transfer is considerably improved.

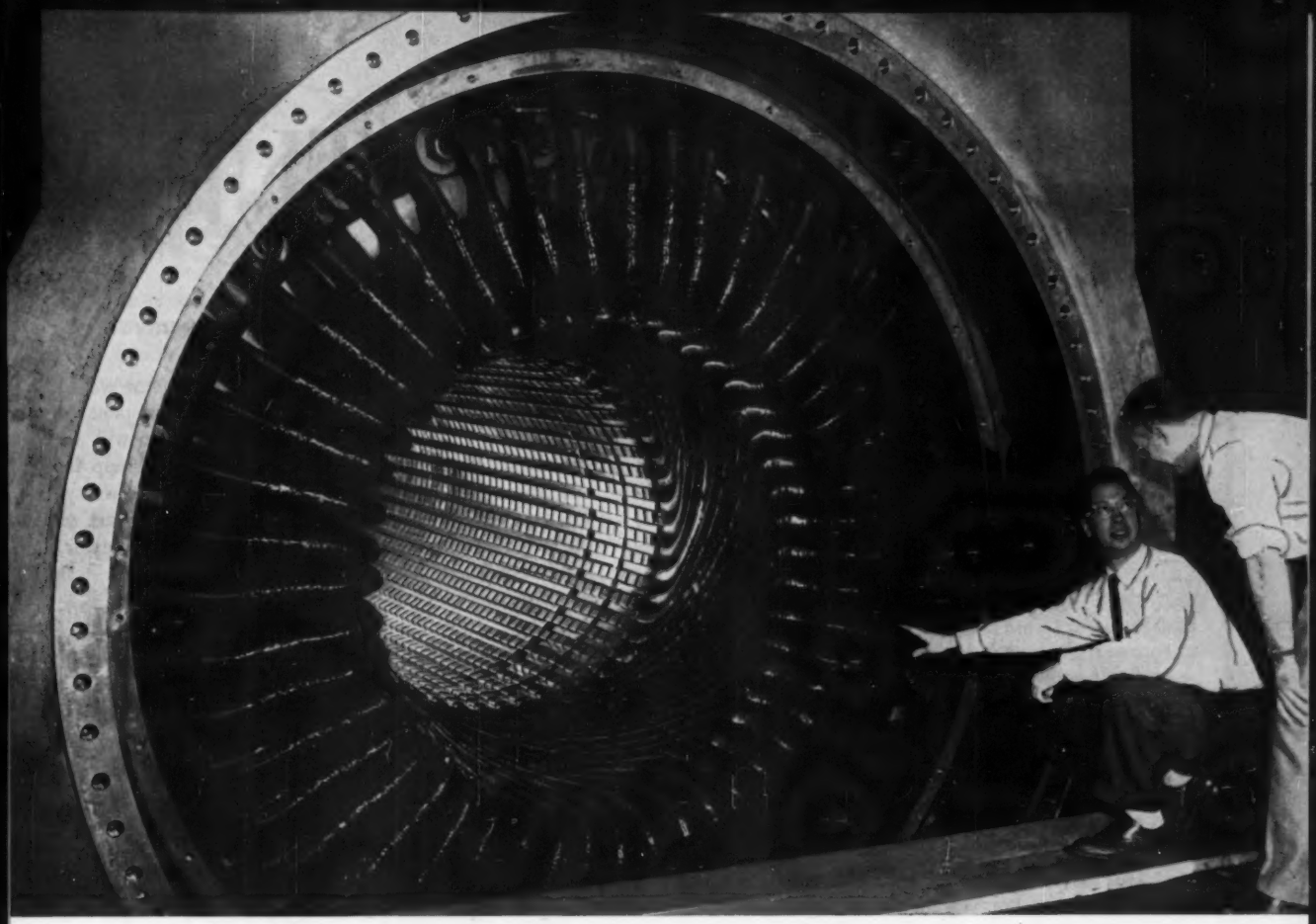
COMPLETELY INSULATED, the liquid connections between the stator bars and the liquid header leave no exposed copper. Note the design simplicity of this turbine end of the generator. The collector end also is extremely simple and has the appearance of conventionally-cooled units.

WITH HIGHER RATINGS NOW POSSIBLE FOR GENERAL ELECTRIC GENERATORS...

Liquid cooling system maintains



THE LIQUID CONNECTIONS between the stator bars and the liquid manifolds provide complete electrical insulation. This simple arrangement at the turbine end of the generator is mechanically flexible and provides the long, reliable life required for turbine-generator operation.



dielectric simplicity and reliability

COMPLETE LINE-TO-NEUTRAL INSULATION ELIMINATES EXPOSED COPPER SURFACES

Despite the tremendous increase in unit output now available with direct liquid cooling of generator stators, the dielectric system remains basically as simple as for conventionally-cooled machines.

Complete insulation of the winding is provided, as in conventional cooling arrangements. Thus, with no exposed copper surfaces, possibility of electrical creepage flashover to ground is practically eliminated.

Within the stator bar, only insulation between strands is required since there are no central cooling ducts to insulate. Not only does this provide more effective utilization of stator slot space and better heat transfer, but it makes possible the simplest dielectric construction of the stator bar.

Dielectric simplicity is just one of the many important features of General Electric liquid-conductor-cooled generators. Other outstanding advantages are:

Increased Generator Output—*Hollow strand stator bar construction can remove up to 16 times more heat than conventional cooling arrangements, permitting higher generator ratings.*

Improved Performance—*Liquid cooling permits automatic regulation of stator winding temperature independent of load.*

Dependable Operation—*Many unique features are incorporated into the design of the closed coolant system to provide a permanently tight liquid circuit.*

Shorter Maintenance Inspections—*Simple, single-stage, low-pressure hydrogen circulating fans facilitate disassembly and inspection.*

For more information on liquid cooling, contact your nearest Apparatus Sales Office or write to Section 254-75 for bulletin GER-1231, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

OPERATION UPTURN:

Excerpts from the report of Ralph J. Cordiner to General Electric share owners:

IN the light of economic circumstances today, what must be done to bring about the resurgence of business and employment that everyone wants? The situation seems ripe for a special effort: consumers have the money to spend, industry is tooled up to deliver as never before, and there are signs that the upturn is trying to get under way.

Opportunities to serve customers better

It seems to me that the most practical and effective course right now is for every business to buckle down and sell goods as never before. I mean a total effort, by every man and woman on the job, to concentrate on giving customers the best service and the best reasons to buy they ever had. King Customer needs some constructive attention. He is willing to do his part, if he is convinced that this is the time to buy. Let's convince him by showing him the best values and by giving him the best service he could ask for.

This may seem like an old-fashioned prescription to those who are shouting for massive government make-work programs and meaningless tax cuts, but we in General Electric are convinced that what happens to the economy in the remainder of this year will be largely determined by what business does to help its customers and itself. This is a do-it-yourself country. Each of us is in some way responsible for a part of the total effort, as a consumer, an employee, an investor, a voter, or whatever roles we play in economic life.

That is not to say that federal, state, and local governments do not have important work to do. There are many constructive measures that would stimulate a sound recovery without sowing the seeds of future inflation. What I am suggesting is that the government must provide the political conditions in which the economy can work its way out of the recession; but the government cannot be expected to cure the recession.

Outstanding values available now

General Electric's three-year, $500,000,000 program of capital expenditures, which was announced in 1955,

Over 3,000 share owners—a typical cross section of the nearly half a million Americans who are owners of General Electric—listen to the president's message by Ralph J. Cordiner at the Annual Meeting held in April at Schenectady, N. Y.

A nation-wide "do-it-yourself" program to help build sales and jobs in 1958

is proceeding on schedule. This modernization and expansion program has put the company in an excellent position to give its customers outstanding values and up-to-date products.

The competitive industry prices at which General Electric sells have remained about level, in spite of the continued rise in costs. Customers are getting unusual values at today's prices, and this will help build business volume back up to the normal trend. Looking at the situation realistically, however, such bargain prices cannot be expected to continue indefinitely.

In addition, the company is offering improved credit terms that recognize the problems of the times. More advantageous terms have been made available through the General Electric Credit Corporation, such as the Unemployment Protection Plan to aid customers through periods of unemployment due to sickness or layoff.

A program to accelerate the upturn

This is a moment of opportunity. The slight upturn in some sectors can be turned into a definite trend, and then snowball into a steady recovery, if business will make a fresh, concerted effort.

To this end, the General Electric Company today announces that it is setting in motion a company-wide program of aggressive action in all departments and in all functions to accelerate the upturn in business.

It is known as OPERATION UPTURN. Basically, it is a program to accelerate the upturn in business by bringing extra values and renewed confidence to customers. Its purpose is to build sales and jobs in 1958. All across the country, other companies are announcing their own plans to stimulate sales and renew public confidence. OPERATION UPTURN is part of this exciting national picture of the people of the United States shaking themselves loose from the doubt and confusion of recent months and setting about purposefully to resume the national advance.

Remember, programs such as this, even if they are conducted by all the leading companies in the country, cannot work overnight miracles. But the tide is turning, and this is the time for a massive effort by everyone to keep the economy moving in the right direction. All signs indicate that this country can have its biggest surge of growth in the 1960's.

OPERATION UPTURN . . .

is General Electric's program to help accelerate the upturn in business by bringing extra values and renewed confidence to customers. Its purpose is to build sales and jobs in 1958 through the enthusiasm and participation of more than a quarter million employees, their community friends and neighbors, some 45,000 suppliers, more than 400,000 firms that sell or service the company's products, and nearly half a million share owners. OPERATION UPTURN can help all of us together to contribute more effectively toward our common goals and add confidence and strength to the nation's economy.

Responsibilities for every citizen

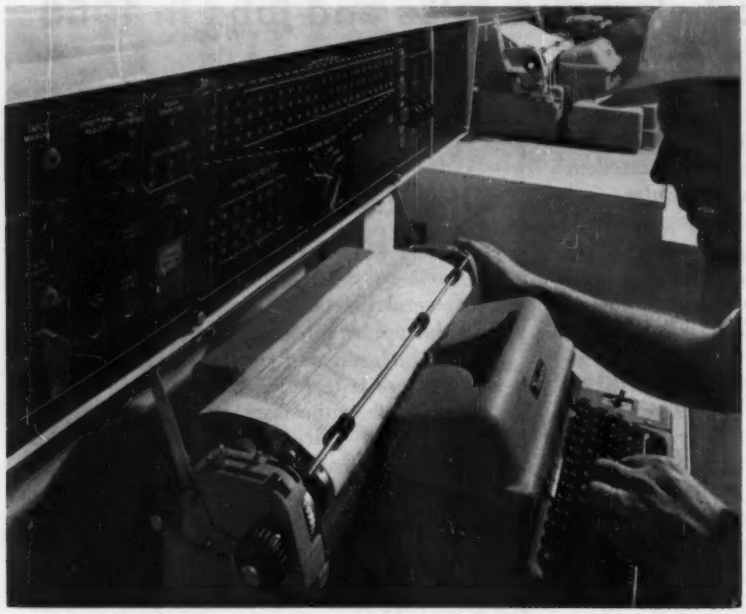
In a free economy, economic growth is paced and directed by the decisions of millions of businessmen, consumers, investors, employees — indeed, by every citizen. The faith of our society is that these millions of points of initiative will produce swifter progress, with greater liberty, than any system of centralized control.

Thus, a business recession is really a test of the American people and their form of society. Their decisions — to buy, to invest, to modernize, to work more purposefully, to raise their levels of living — will determine the speed of economic advance. They will also decide whether Russia will, as she has announced, surpass us in the years ahead.

It is my opinion that the American people will bring about the upturn this year and head into a great surge of growth that will leave both the recession and the Russians far behind. This is what we Americans want. And what we want, we are willing to work for. That is all that is needed.

Progress Is Our Most Important Product

GENERAL ELECTRIC



INSTRUCTIONS to the computer are typed on this control console of the transistorized system at La P&P's Sterlington Station. "Printers" in the background tell the operator what is happening at 350 points around the plant

Computer Gives Automatic Plant Record

First transistorized general purpose digital computer, which will give an automatic record of power plant operating conditions is going "on-line" at the new 210,000-kw unit at Sterlington Steam Station of the Louisiana Power & Light Co near Monroe, La. For the first time, a power plant control room will be devoid of most of the usual array of dials, gauges and recorders.

Developed by Daystrom Inc, Daystrom Systems Div, La Jolla, Calif., the new Operational Information System is installed at the plant, designed and constructed by Ebasco Services, Inc. The system handles 350 points at a rate of 5 points per sec.

According to Louisiana Power & Light engineers, the Daystrom installation will automatically measure 250 temperature points, such as bearing and oil temperatures, boiler temperatures, steam temperatures, transformer temperatures, and other temperatures important to plant operation. Should any of these temperatures register higher or lower than a preset point, an alarm will sound, and the reading will be printed out on a separate unit indicating its location in the plant.

The system will also print at regular time intervals 100 plant readings necessary for accounting and trouble-shooting records. At any time the operator desires, the unit will produce a written record of any of the measurements in the system.

Heart of this new installation is the transistorized computer, utilizing a memory unit presently capable of storing 2,048 different pieces of information with provisions for increasing this storage to 16,384.

The system automatically converts analog information into digital form, that is, it assigns definite figures to the incoming variables, such as the voltage produced by a thermocouple. They are then fed into the computer, and all computations are performed digitally without loss of accuracy.

Engineers at Louisiana Power & Light stated that the equipment was not installed to save manpower, but primarily to provide operating experience with the type of equipment that will eventually be used in the completely automatic power plant.

L&N Develops Instrument Panel to Train Customer

Instrument engineers and technicians in the power industry now have the advantage of an instrument panel in customer training at Leeds & Northrup Co, Philadelphia, Pa.

The recently completed panel is a working tool, believed to be the first of its kind. It consists of 13 L&N controllers and recorders which operate under "actual conditions" as experienced in power and various major industries. Process simulators, connected to the panel instruments, feed the equipment with signals like those given in a plant. Students are enabled to learn installation, application, and maintenance as it applies to their particular fields.

This training device is the major "textbook" of L&N's tuition-free training. The two-week course can accommodate 40 students at one time.

RT&E Splits Stock, Has 21% Earnings Gain

RT&E Corp shareholders voted for a 20-for-1 stock split at the recent annual meeting at Waukesha, Wis.

Annual report of the distribution transformer manufacturer shows net earnings of $310,664, a gain of more than 21% in 12 months, on sales of $4,338,739 for the fiscal year ending Mar. 31, according to Rolland D. Nelson, president.

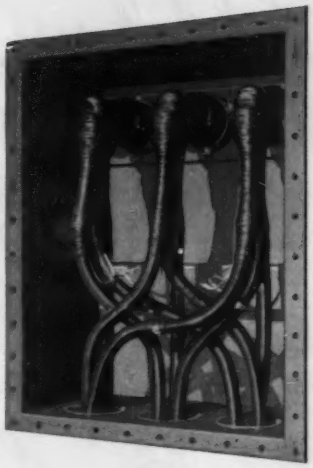
At present 14,500 shares of RT&E common stock are issued at no par value, but with a stated value of $20. Issuance of 300,000 shares with a $1 par value was authorized by the shareholders.

(*More Manufacturers News, page* 66)

PARANITE®

SUPER-PARARITE® PARAPRENE®

CABLE



Installed at Turkey Creek

Here's another example of power—Paranite—and American industry . . . the selection of Super-Pararite Paraprene Cable for the new Turkey Creek Pumping Station at Kansas City, Missouri. The Super-Pararite butyl conductor insulation is recognized for superior resistance to heat, cold, moisture, oxidation and ozone, while the Paraprene neoprene jacket possesses inherent resistance to sunlight, abrasion, ozone, heat, oil and chemicals . . . one of many Paranite products which has earned the industry reputation—

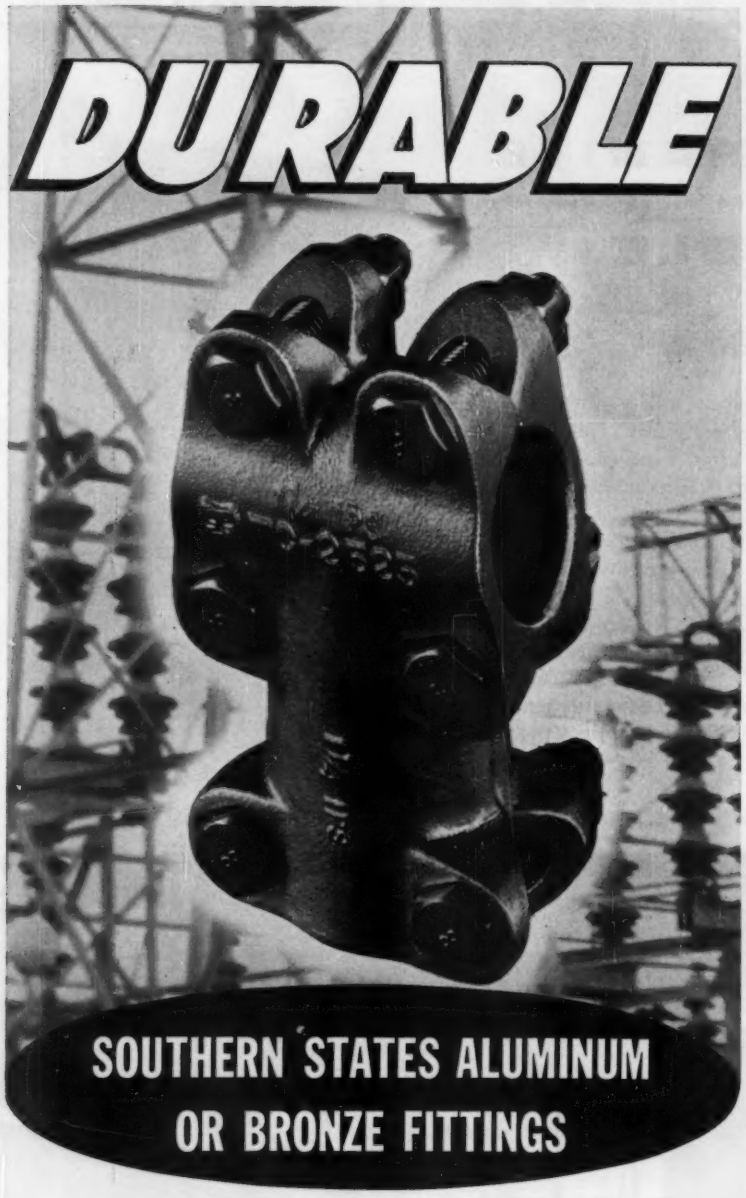
"IF IT'S PARANITE IT'S RIGHT."®

PARANITE WIRE AND CABLE DIVISION

Essex Wire Corporation, Fort Wayne 6, Indiana

MANUFACTURING PLANTS: Birmingham, Ala.; Anaheim, Calif.; Jonesboro, Ind.; Marion, Ind.; Tiffin, Ohio

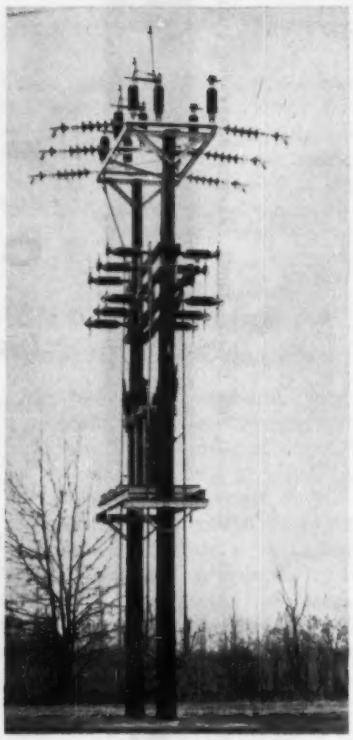
Sales Offices in all Principal Cities



Knowing that fittings are often re-used, Southern States has designed its entire line with easy, on-the-job assembly and re-assembly foremost in mind. Southern States connectors and bus supports have recessed hexagonal bolts, assuring easy and rapid "one-wrench" installation or removal. Each connector fits properly, has ample strength, and is sufficiently rugged at stress points. *Never underestimate the importance of a good connection!*

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto



Recloser Facility Readily Mounted on Pole Structure

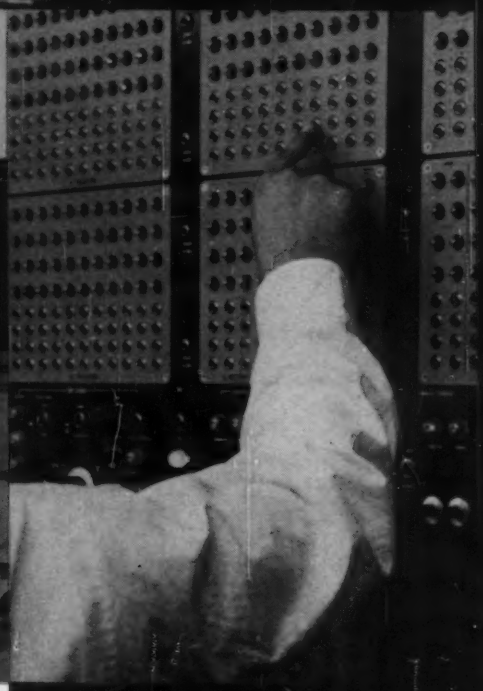
An automatic circuit recloser facility to provide fault clearing incorporates 46-kv reclosers made by R&IE Equipment Div of I-T-E Circuit Breaker Co, Greensburg, Pa. The reclosers, which can be mounted on frame structures between poles to eliminate the need for land purchase, can be hoisted and mounted in about a half an hour. The facility shown here is the Lambertville Junction of Consumers Power Co, Jackson, Mich. It comprises three pole-top air-break switches, three H-frame-mounted reclosers and six disconnects in mid-pole position.

Method Corrects Mistakes in Data Processing

A method to insure virtually uninterrupted accuracy in electronic data-processing by correcting mistakes "on the fly" at electronic speeds has been developed by the Datamatic Div of Minneapolis-Honeywell Regulator Co.

(*Continued on page* 68)

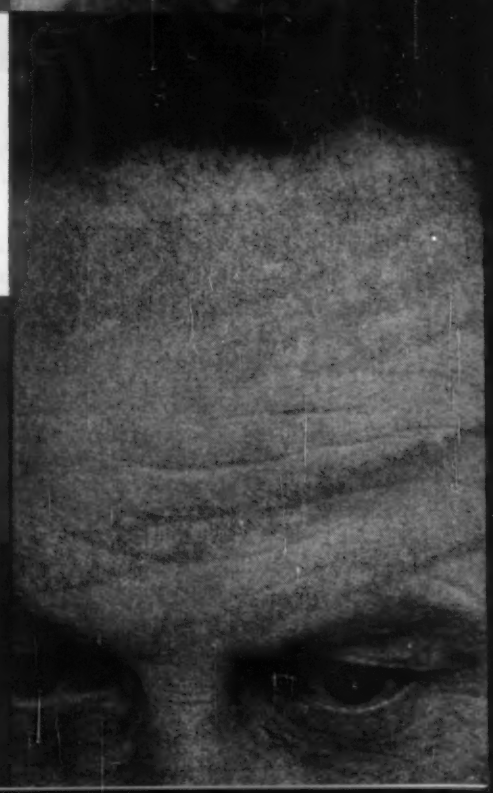
Fluor's Datatron digital computer frees engineers from routine computation, permitting full use of their creative design talents. Its ability to quickly perform intricate calculations without error shortens engineering lead time . . . assures maximum precision and efficiency in completed plants.



***WHEN** you consider expansion...*
the most important investment
you can make is in
the creative ability of men.

FLUOR

The Fluor Corporation, Ltd.
Engineers & Constructors
2500 S. Atlantic Blvd., Los Angeles



Ask your

Westinghouse representative

about the exclusive benefits

you get from

URL AND URF

REGULATORS...

WITH 1¼%-STEP

REGULATION

Westinghouse URL and URF voltage regulators, with 1¼% steps, provide improved regulation . . . with a minimum of corrective operations. Here's why:

The "set" bandwidth describes the limits outside of which voltage correction is called for. Since correction stops when voltage is brought back within the band, smaller steps require narrower band settings for the same quality of regulation . . . but narrower band settings require extra tap-changer operations.

Thus, the 1¼%-step regulation of Westinghouse URL and URF regulators provides an effective voltage that is closer to the balance voltage—the narrowest *effective* bandwidth, with the *fewest* operations.

Call your Westinghouse representative for the complete story about this special quality of regulation—the result of PLOWBACK OF EARNINGS into research to provide better methods for voltage control in your electrical distribution system.

J-70861

YOU CAN BE SURE...IF IT'S Westinghouse

Method Corrects Mistakes

(*Continued from page 66*)

The new system, called Orthotronic Control, literally recreates source data by a form of electronic detective work and provides instant data reconstruction of lost or garbled words or figures when discrepancies are automatically spotted at any one of a series of check points throughout the system.

The system has been started in production at Datamatic's two plants near Boston, and will be ready for service with existing and future Datamatic 1000 systems in the second quarter of 1959, the company announced.

Gas-Insulated and 200Mva Transformers Made by GE

Significant transformer designs by the General Electric Co include gas-insulated type with load-tap-changing equipment, and a 200,000 kva high-voltage unit. Their descriptions and destinations follow:

• Orders for two gas-insulated transformers of a new design have been received recently. Both will have load-tap-changing equipment and sound levels appreciably lower than comparable oil-filled units, according to company's Power Transformer Dept, at Pittsfield, Mass.

One transformer, now in final design stage, is rated 9,375 kva, 67-12.57 kv. It will be shipped early in 1959 to a substation of Houston Lighting & Power Co.

The other transformer is rated 7,500 kva 39.4 - 4.8 kv. It will be designed for standard substation operation and shipped in mid-1959 to Detroit Edison Co.

Both transformers use a heavy gas, sulfur hexafluoride, instead of oil for insulation and cooling. Some advantages of the gas are: Good dielectric and heat transfer medium, non-flammable, non-toxic, elastic and a poor transmitter of sound.

The two orders make a total of five gas-filled power transformers built or being built by GE, with a total capacity of more than 30,000 kva. Largest single unit designed to date is 10,000 kva in the 69 kv class.

• A 200,000 kva, 230 - 121 kv,

grounded Y, autotransformer with bushing-mounted load tap changers was shipped recently to the Plattsburgh substation of the New York State Power Authority. This forced-oil-cooled, 3-phase autotransformer, the largest built by GE, is to deliver St. Lawrence power from Barnhart Island plant to the Plattsburg area and State of Vermont.

By using the bushing insulation for the contactor, the LTC equipment can be connected directly into the high-voltage winding without the use of a series transformer, making the whole equipment smaller, lighter and more efficient, it is reported.

All capacity of tertiary winding will be an alternate 13.2-kv supply.

MANUFACTURERS BRIEFS

Electric Storage Battery Co, Philadelphia, Pa. is now in its 70th year. When it started in business in 1888, the company had a total capital of $10 million, of which only $2,500 was in cash, said Carl F. Norberg, president. "All the other assets consisted of patents covering storage batteries. In other words, the company was founded on a very small amount of working capital, one product line (standby power for the electric lighting industry) and a great deal of faith and enterprise," noted Norberg.

Line Material Industries, Milwaukee, is marketing a tubeless photoelectric control for lighting. Photo cell operates 1,000-w load relay. Three-prong plug mounts control on luminaire. Unit is built by Tabet Mfg Co, Norfolk, Va.

De Laval Steam Turbine Co, Trenton, N. J., is preparing two barrel type boiler feed pumps for delivery to the Danskammer Point Station of Central Hudson Gas & Electric Corp, Poughkeepsie, N. Y. The pumps are 12-stage units designed to deliver 1140 gpm of 325F against 3,173 psig discharge pressure. They will make a total of six constructed for the station by De Laval.

Southern State Puts Display on Road

A mobile display has been assembled to demonstrate the Southern State Equipment Corp's, Hampton, Ga., line of switches, fuses and power fittings. Here it is being given a final check by Olan Richardson, right, president, and J. E. Cordell, vice president, sales. This display is in a station wagon and the equipment rolls out on special channel bases when being exhibited. It will tour a large portion of the U. S. Presently it is being used throughout the territory served by Rumsey Electric Co, representing Southern States Equipment Corp.

Westinghouse

1¼%-step

regulation . . .

REQUIRES FEWER OPERATIONS, INCREASES CONTACT LIFE

Westinghouse URL and URF regulators with 1¼% steps require 42% fewer operations to maintain the narrowest *effective* bandwidth. This means that:

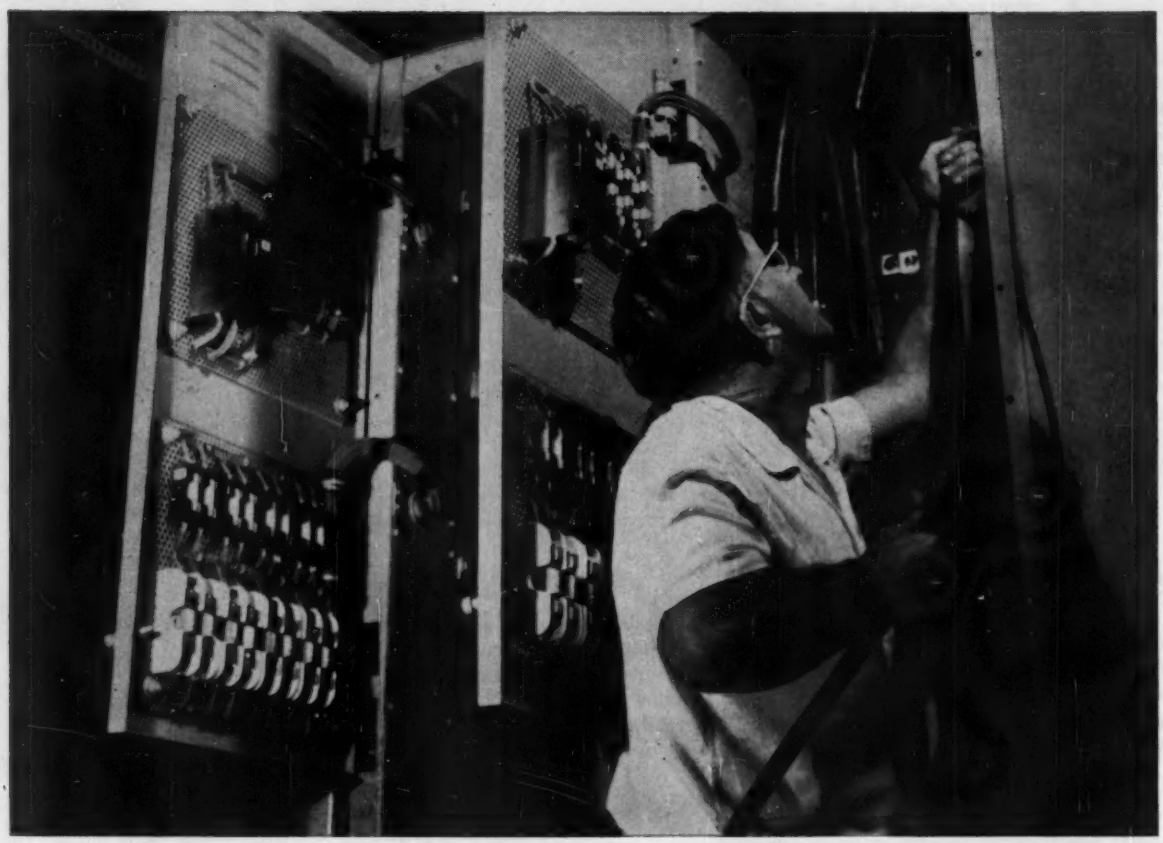
- Contact life is increased.
- Oil carbonization is reduced.
- Maintenance costs drop.

For better regulation, insist on the total package: 1¼% step, inverse-time relay, instant-response tap changer.

J-70862

YOU CAN BE SURE...IF IT'S

Westinghouse



When you must pack a lot into a small space . . . specify Rome's "CT-2" control cable

These cables are intended for installation in underground conduits or ducts, directly in the earth, or open air.

Conductors: Conductors conform to ASTM Specification B-8.

Insulation: Insulation conforms to IPCEA Appendix P.

Color Coding: All conductors shall be color-coded in accordance with IPCEA recommendations.

Assembly: For three conductors or more, the insulated color-coded conductor shall be twisted with jute fillers when necessary to make round, and a suitable tape shall be applied over the assembled core. Two-conductor cable shall be flat.

Over-all Sheath: An over-all sheath of Rome Synthinol* shall be applied over the tape core.

Here's a way to speed up the job of making complex control-panel connections in tight quarters. Install cable that meets your *budget*, *quality*, and *space* requirements.

You'll find that just such a cable is Rome's "CT-2" control cable. Its smaller diameter will fit into your most compact panel arrangements. It's lightweight, too, and easy to pull through conduit. And it represents good quality at moderate cost.

Your choice of cable sizes

This low-surface-friction cable has an all-thermoplastic construction featuring 3/64" Rolene insulation (polyethylene) plus an over-all sheath of Rome Synthinol (polyvinyl chloride).* It's available as a standard construction with one to 12 conductors in No. 9 and No. 12 AWG sizes.

Insulation: Sure and dependable terminations are possible because Rolene strips cleanly. This smooth, positive-stripping polyethylene lets you consistently make an efficient installation.

Sheath: Rome Synthinol is a thermoplastic (PVC) compound that offers high resistance to oils, most acids, alkalis, grease, gasoline, weathering and flame.

Use Rome's "CT-2" control cable for your next job where space is at a premium and fast, efficient installation is mandatory.

Find out how Rome's control cable can fit your installation picture. Contact your nearest Rome Cable representative—or write to Department 852, Rome Cable Corporation, Rome, N. Y.

*Alternate sheaths of Rolene (polyethylene) or Roseal (flame-resistant polyethylene) are also available.

ROME CABLE
CORPORATION

In "The Management Newsletter" of May 5, 1958, the "Report on Rate of Return" showed that companies in "fair value" jurisdictions have earned substantially higher rates of return than companies under "original cost" jurisdictions. The question now posed is: How did these better earnings affect the monthly bills of the residential customer?

Report on
Rates and Regulation

Bills Are Lower with 'Fair Value'

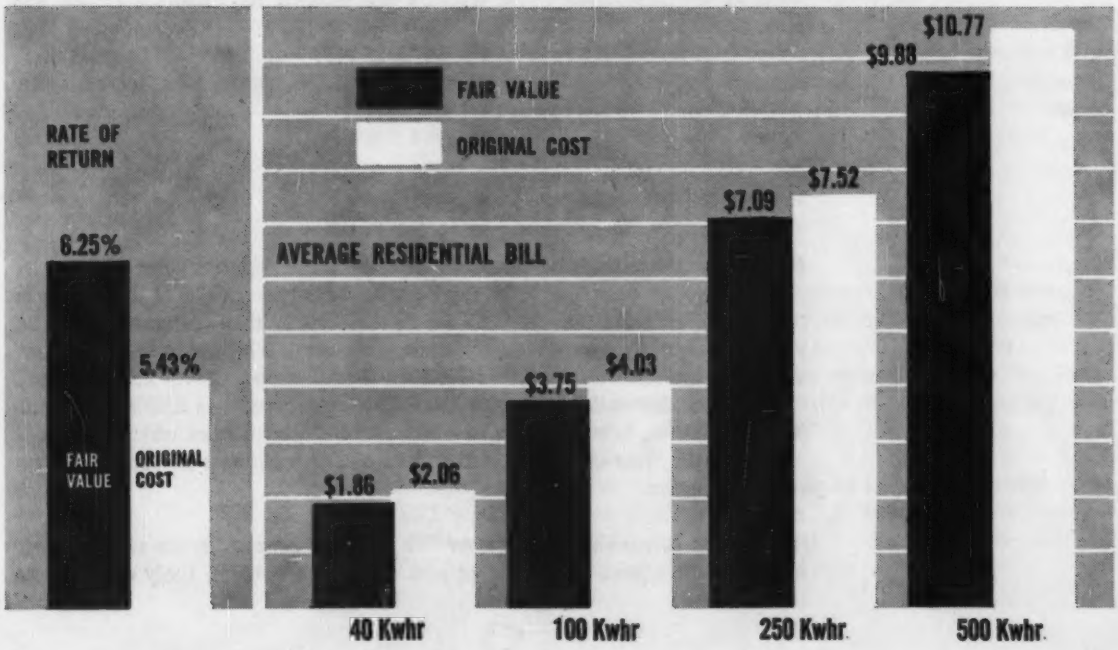
Good earnings benefit the residential customer as well as the stockholder, a study of 102 power companies shows. The study shows that "fair value" companies with better earnings, and companies having better earnings irrespective of jurisdiction, had lower monthly bills according to Federal Power Commission residential electric bill comparisons.

I. Fair Value vs. Original Cost

"Fair value" companies earned higher rates of return than did "original cost" companies, as was shown in the previous study. During 1957, the average rate of return for 38 companies in "fair value" jurisdictions was 6.25%. In "original cost" jurisdictions, the average of 65 companies was only 5.43%.

Average monthly bills were lower in "fair value" jurisdictions in each of FPC's four residential bill classifications, as can be seen in the chart below. In the

Return Is Higher, Bills Are Lower in Fair Value Jurisdictions



250-kwhr classification (nearest the U. S. monthly residential average), bills under "fair value" jurisdictions ran 5.72% lower than bills under "original cost." The average "fair value" customer paid $7.09 for a 250-kwhr bill, as opposed to $7.52 paid by the customer in an area under "original cost" jurisdiction.

In this analysis, latest available figures are used. Rate of return is based on gross income to capitalization on December 31, 1957. Average residential bills are taken from FPC figures as of January 1, 1957.

Bills went up less from 1953 to 1957 in "fair value" jurisdictions, the study also showed. The increase during the four-year period under "fair value" was 17¢, or 2.5%; while "original cost" companies' bills went up 25¢, or 3.4%. Not only were "fair value" bills lower, but the better of the "fair value" earnings seem to have necessitated smaller bill increases.

The greatest advantage under "fair value" accrues to the small customer. At 250 kwhr per month, the customer in "fair value" states pays 5.72% less than the one in "original cost" jurisdictions. The advantage increased to 6.95% in favor of "fair value" for 100 kwhr per month, and to 9.71% in favor of "fair value" for 40 kwhr per month.

At 500 kwhr per month, the "fair value" customer pays 8.26% less for his monthly bill than the "original cost" customer. Bills for 500 kwhr in "fair value" jurisdictions increased only 7¢ (an increase of 0.7%) since 1953, while the customer in "original cost" states had his bill upped by 43¢ a month, or a relative increase of 4.2%.

Among the companies that upped their rate of return from 1953 to 1957, the average increase in annual bill was 3.71%—from $7.27 to $7.54. In "original cost" jurisdictions, bills went up from $7.40 in 1953 to $7.65 in 1957, for an increase of 3.38%. Companies in "fair value" jurisdictions increased bills by 4.12%, but the bills were substantially lower in both years ($7.05 in 1953; $7.34 in 1957). It is interesting to note that these increases during the four-year period compared with an increase of 5.1% in the consumer price index.

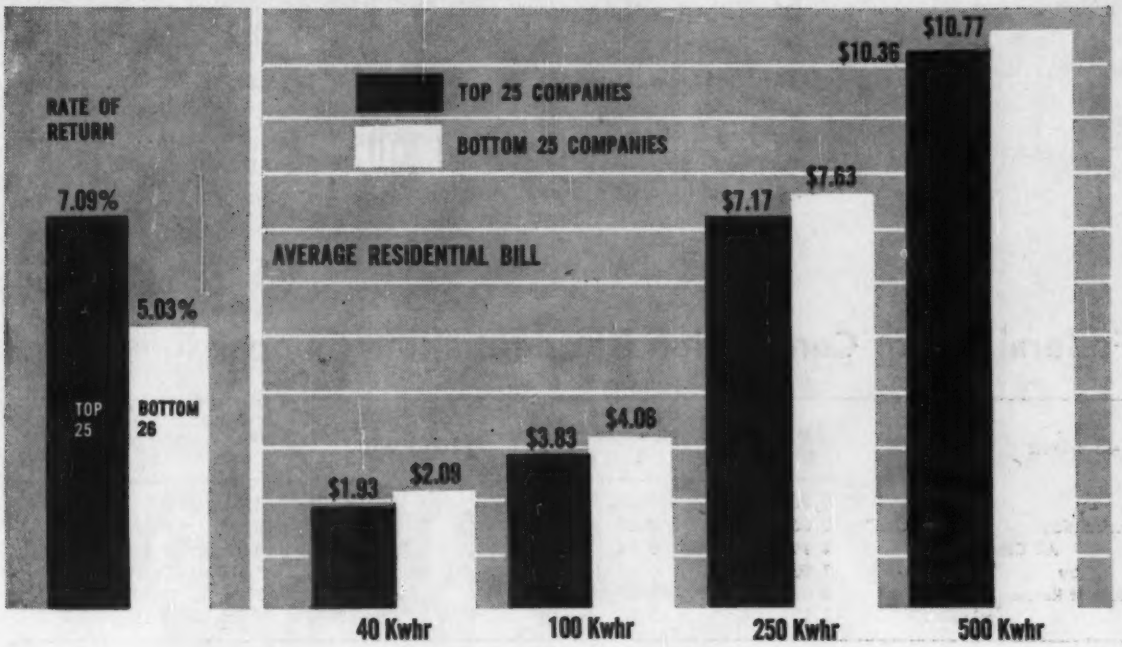
Among the companies whose rate of return decreased from '53 to '57, the bills were substantially lower. The average bill increase for these companies was from $6.85 in 1953 to $7.10 in 1957—a gain of 3.65%. Corresponding "fair value" bills were $6.56 in 1953 and $6.72 in 1957—up 2.44%. "Original cost" companies showed the largest hikes as well as the highest bills, increasing by 4.00% from $7.00 in 1953 to $7.28 in 1957.

II. High Earnings vs. Low

Better earnings benefit the customer. As the chart opposite shows, customers of the 25 power companies with the highest rates of return (20 of these were in "fair value" jurisdictions) paid less for their electricity than customers of the 25 companies with the lowest rates of return (only two of which were in "fair value" states). This was true in all four FPC bill classifications. For a 250-kwhr bill, customers of the top 25 companies paid 46¢ less per month—a 6.03% lower bill. The chart shows bills of only 25 of the bottom 26 companies which were considered in the "rate of return" study, since one of the lowest 26 earners has no retail customers.

The bills of companies earning over 7% are even lower. In the study on rate of return, there were 13 companies with earnings above 7% (only one of these

The Higher the Return, the Lower the Bill



was under strict "original cost" jurisdiction). The average 250-kwhr bill for these 13 top-earning companies was only $6.96—67¢ less than a comparable bill in one of the 25 lowest-earning companies, and 40¢ less than the average of all companies studied.

As to the smaller consumptions, customers buying 40 kwhr a month from companies earning over 7% paid $1.87 as compared with $2.09 for the bottom 25 companies. The 100-kwhr monthly bill came to $3.73 for the "Seven and Over" companies, compared with $4.06 for the bottom 25. The large user also fared better, although this advantage was not so pronounced: The top 13 companies, with rates of return of 7% and over, charged $10.30, while the bottom 25 charged $10.77.

III. How Big Companies Fared

The largest companies collected lower bills, and earned lower returns than average. For the ten largest (by size of capitalization) the rate of return dipped from 5.29% in 1953 to 5.27% in 1957. The average monthly bill for 250 kwhr rose less than 1½%—from $6.90 to $7.00. Such nominal increases in the residential bills of these companies were apparently incapable of counterbalancing inflationary pressure on the rate of return.

The ten largest companies serving metropolitan areas fared considerably better. From 1953 to 1957 their rate of return rose from 5.17% to 5.42%, for a relative gain of 4.9%. The average 250-kwhr monthly bill for these companies increased from $7.14 to $7.42 during the period—a gain of 3.92%.

IV. Tabular Summary

The table below shows the bill comparisons for 1953 and 1957, with increases in dollars and percent. Note that the "fair value" average bill is the lowest in every case. Note also that customers of the "top 25" earners paid lower bills than any other grouping by rate of return except that the "middle 52" group's average bill was 4¢ a month lower for 500 kwhr.

Federal Power Commission Residential Bill Comparisons

40 Kwhr		1957 $	1953 $	Increase $	Increase %
by Jurisdiction	"Fair Value"	1.86	1.80	0.06	3.3
	"Original Cost"	2.06	2.01	0.05	2.5
All Companies		1.99	1.93	0.06	3.1
by Rate of Return	Top 25	1.93	1.88	0.05	2.7
	Bottom 25	2.09	2.02	0.07	3.5
	Middle 52	1.97	1.91	0.06	3.1
250 Kwhr					
by Jurisdiction	"Fair Value"	7.09	6.92	0.17	2.5
	"Original Cost"	7.52	7.27	0.25	3.4
All Companies		7.36	7.14	0.22	3.1
by Rate of Return	Top 25	7.17	6.99	0.18	2.6
	Bottom 25	7.63	7.43	0.20	2.7
	Middle 52	7.33	7.08	0.25	3.5

100 Kwhr	1957 $	1953 $	Increase $	Increase %
	3.75	3.61	0.14	3.9
	4.03	3.90	0.13	3.3
	3.93	3.79	0.14	3.7
	3.83	3.73	0.10	2.7
	4.06	3.94	0.12	3.0
	3.91	3.75	0.16	4.3
500 Kwhr				
	9.88	9.81	0.07	0.7
	10.77	10.34	0.43	4.2
	10.44	10.15	0.29	2.9
	10.36	10.23	0.13	1.3
	10.77	10.46	0.31	3.0
	10.32	9.95	0.37	3.7

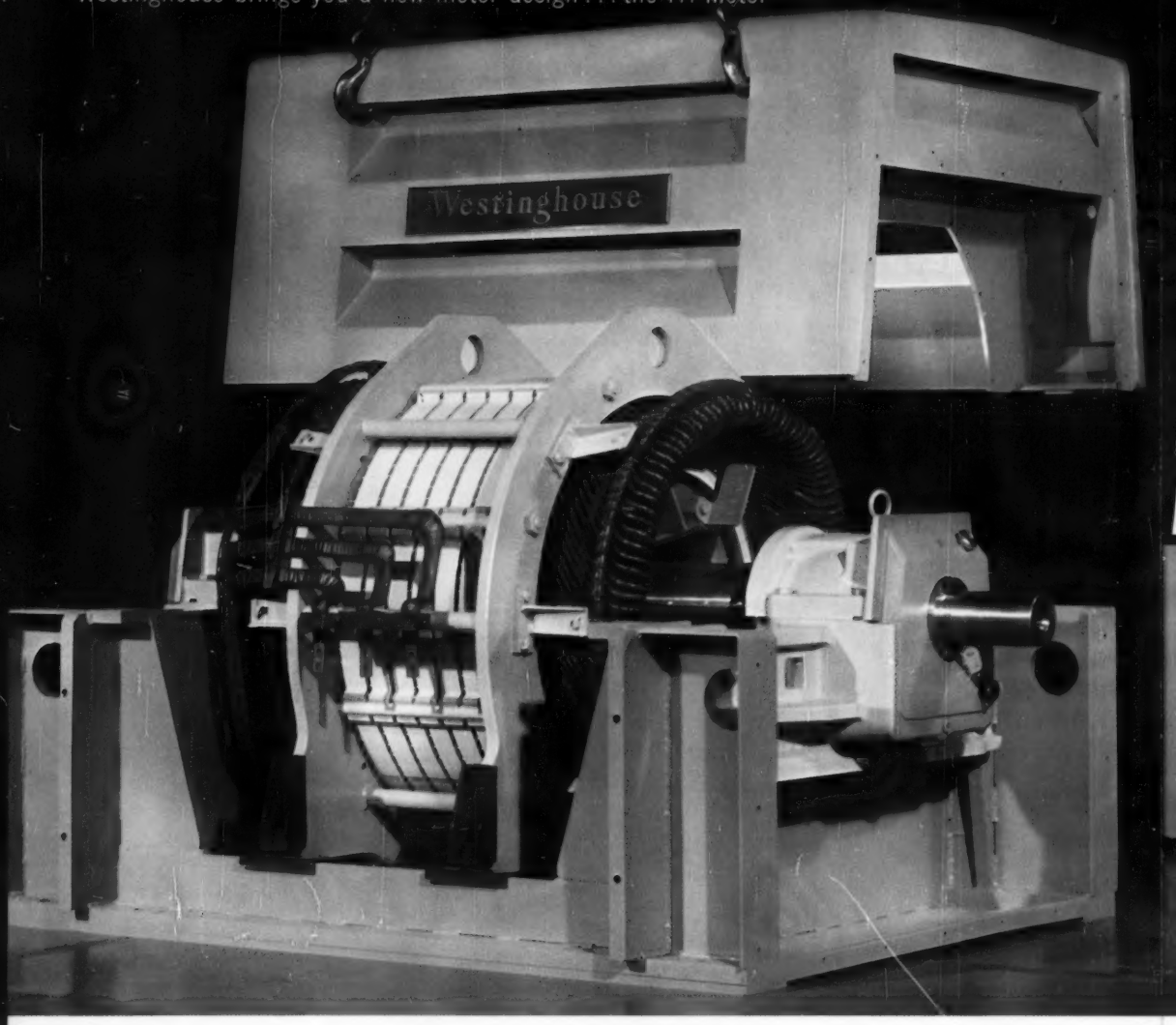
While the average bill increases from 1953 to 1957 in the 40-kwhr and 100-kwhr classifications were only 1¢ a month more for "fair value" than for "original cost", the increase at 250 kwhr per month (or approximately the national average) amounted to 8¢ less—only 17¢ for "fair value" companies as compared to 25¢ for those in "original cost" jurisdictions.

V. Conclusions

There appears to be a paradox in the fact that "fair value" companies with rates of return substantially higher than those in "original cost" jurisdictions are able to offer their services at rates considerably lower. This study makes no attempt to analyze all the other factors which enter into the overall earnings position of a company. On a spot check, however, it was found that commercial lighting service bills for 750 kwhr per month with a billed demand of 6 kw were about 2% less for companies in the "top 25" group compared with the "bottom 25" group of earners.

While only good management can initiate better earnings, the continuance of good management is in turn dependent on sustained good earnings. This type of management will be able to operate more economically, less on a piecemeal basis, and with long-range economies in mind. In other words, good earnings must result in economies which management is able to pass along to consumers.

Westinghouse brings you a new motor design . . . the FA Motor



revolutionary take-apart housing

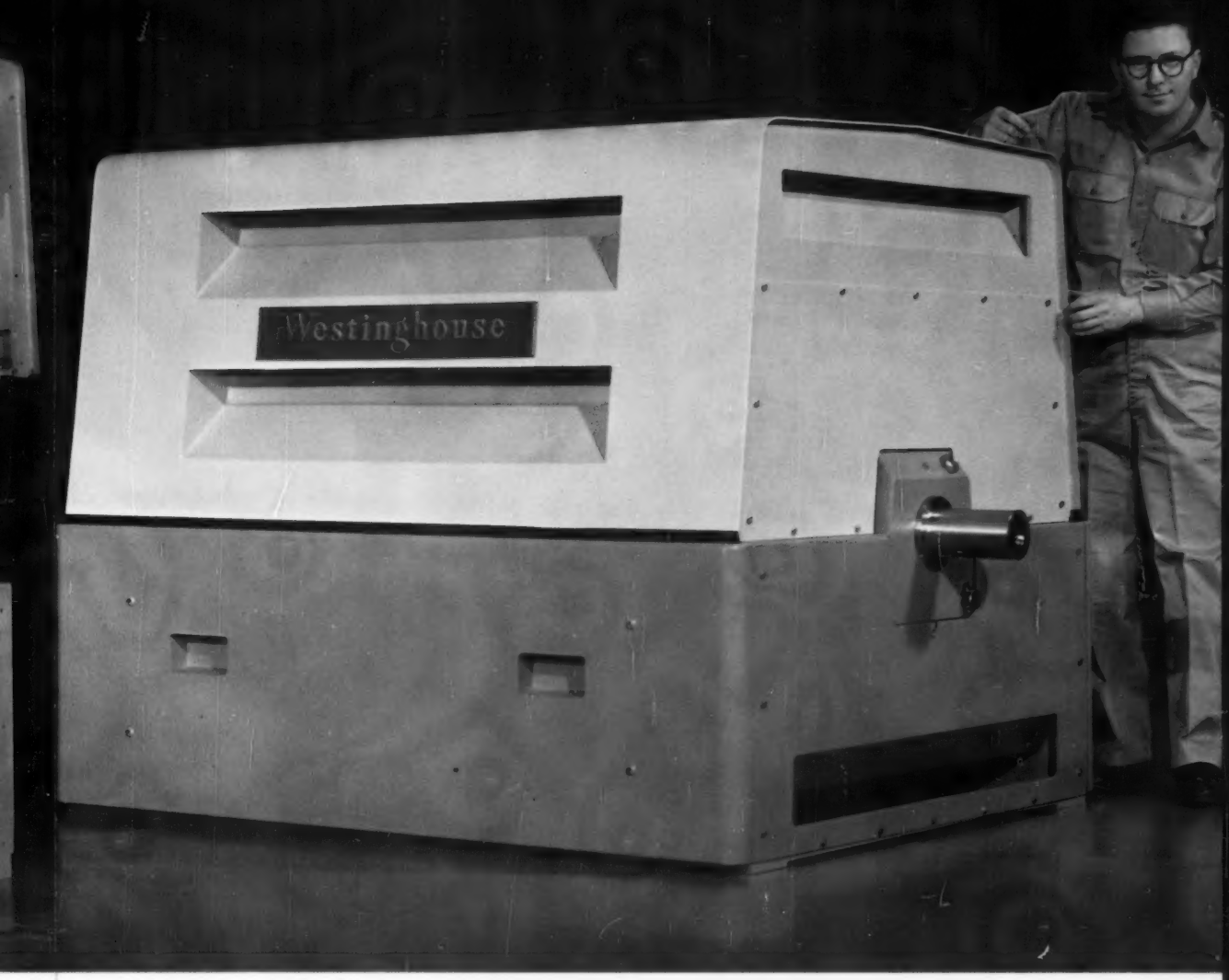
takes guesswork out of inspection

This modern motor concept combines the well-known reliability of Westinghouse large motors with a new and vitally important extra—*full accessibility!*

For the first time, the motor housing is completely separate from the stator, with all the benefits such construction implies. Inspection—once a matter of partial visibility and guesswork—is now an easy and thorough operation which insures your motor investment.

YOU CAN BE SURE...IF IT'S

Westinghouse



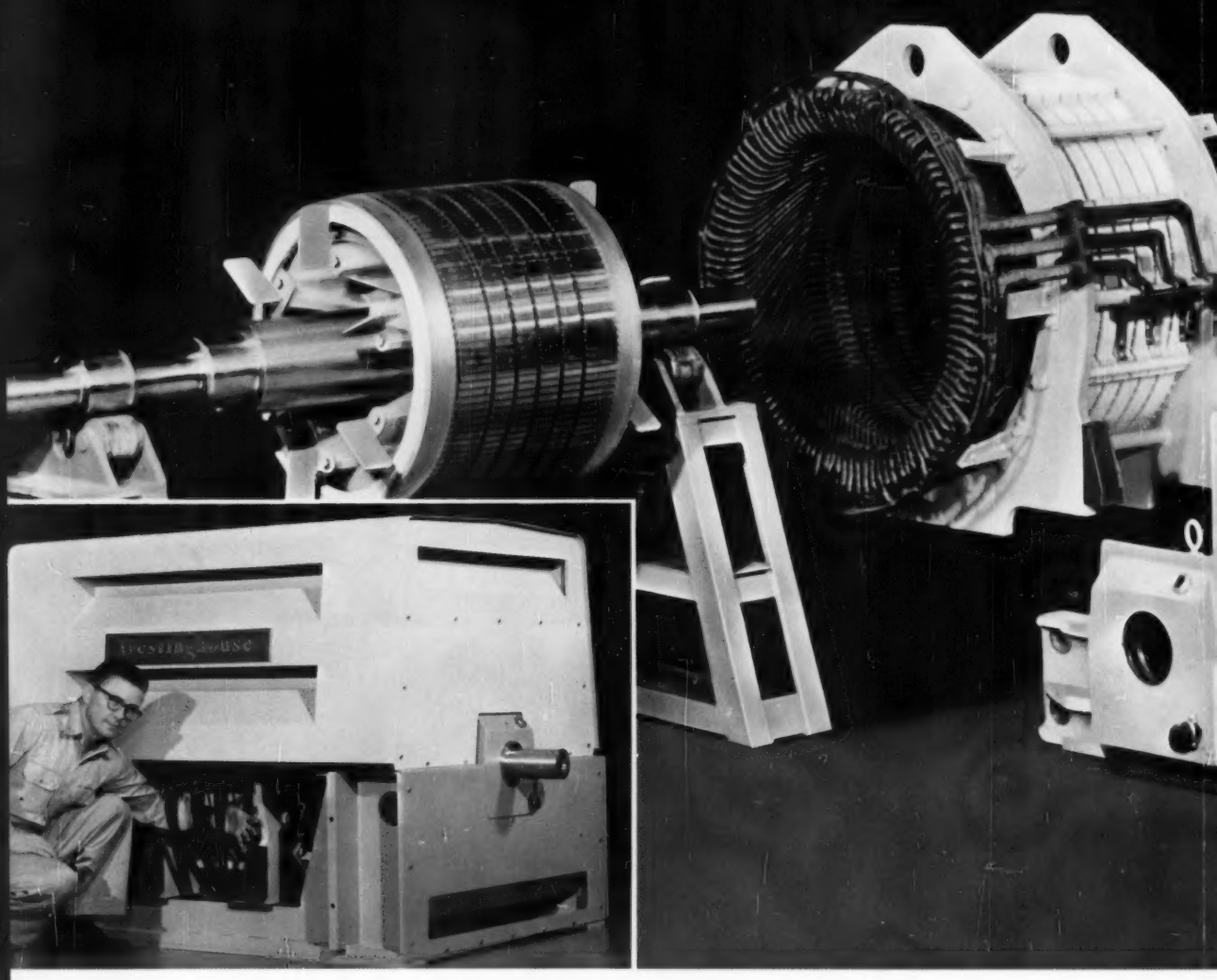
The new Westinghouse FA Motor gives you five major advantages

1. Full accessibility. Total inspection is possible for the first time. Enclosures are quickly removed, easily replaced. Reassembly is automatically precise.
2. Inherently quiet. Housing is isolated from the stator, reducing transmission of vibration and noise.
3. Thermalastic insulation. Recognized as the finest available, it assures long life and protection of coils.
4. The same basic components—rotor, stator and bearings—which have made Westinghouse motors famous for long, efficient service life.
5. Easy to connect. No conduit box. Cables pass through the base bottom with extra-ample room to connect motor leads.

These qualities make the FA Motor your best investment. It is available in ratings from 250 hp up to 7000 hp, depending on speed. For full information, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. JI-15005

YOU CAN BE SURE...IF IT'S

Westinghouse



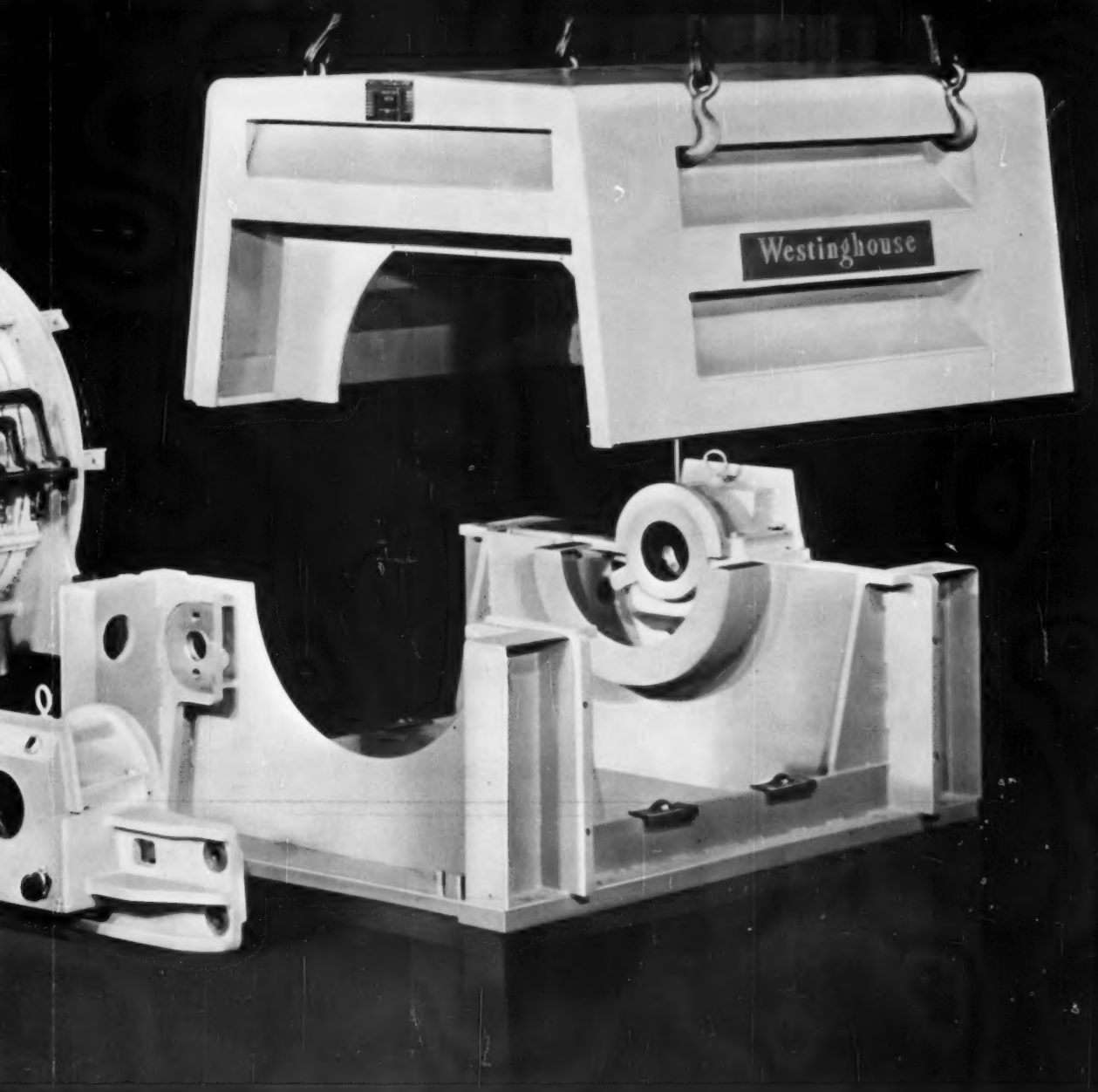
Protruding conduit boxes are gone. Cable comes through the base, leaving plenty of room for connecting motor leads.

By merely removing the end panels, you can see and inspect windings and bearing assemblies. Bearing assemblies come apart quickly for inspection. Remove bearing cap, top bearing shell and oil ring; then the bottom bearing shell rolls out for quick, easy bearing inspection.

Top performance combi
means greater motor va

The time-tested and-proved Westinghouse motor components which have always given you the best in dependable performance are now housed in completely removable enclosures. Advantages impossible in conventional motors are standard features of this modern-as-tomorrow FA Motor design.

- Now, when you specify an FA Motor, the outlines and dimensions are immediately available.
- Now, independence of housing from the stator enables you to make complete visual

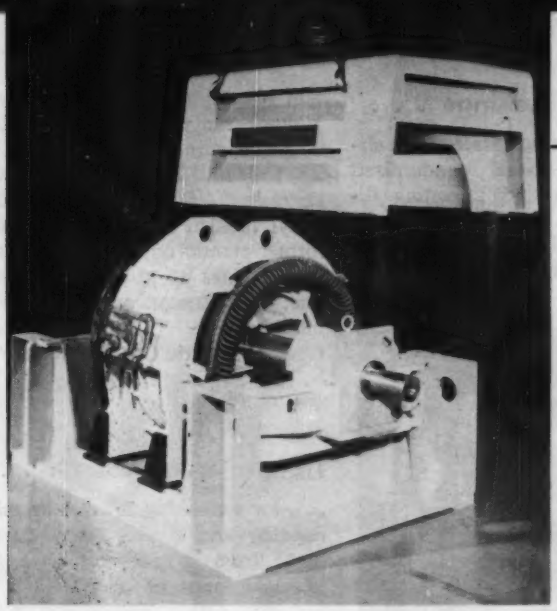


mbined with full accessibility
r value

inspections of the windings.

- Isolation of stator from housing also makes the motor inherently quiet.
- Exclusive plunge-bored brackets permit precision alignment of bearings. Each time the motor is reassembled, these brackets precisely maintain alignment of the rotor.
- Special locator joints simplify removal and replacement of the stator. By removing four bolts, the stator assembly is freed from the base. In reassembly, these ball-type joints automatically assure perfect realignment.
- Thermalastic® insulation, an exclusive feature in all Westinghouse large motors, adds further insurance that you're getting the very best in motor quality and performance. Since 1949, Thermalastic insulation has extended the service life of coils in large motors, generators and other large electrical rotating apparatus.

YOU CAN BE SURE...IF IT'S
Westinghouse



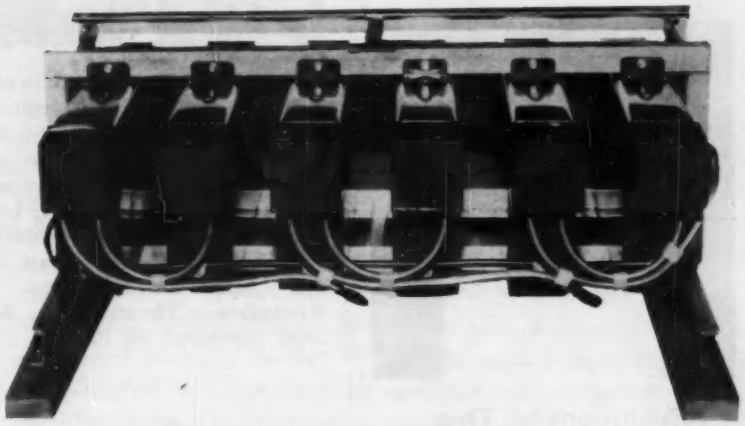
New Equipment

Fully Accessible Motors . . .

. . . include squirrel cage, wound rotor, and synchronous motor from 250 to 7,000 hp. Complete line uses only six basic enclosures and 30 frame sizes, compared to 450 frame sizes formerly used. Stator is accessible for thorough inspection. Enclosure can be replaced without alignment. Filters, mufflers, and accessories can be added to the F/A (fully assembled) motor without redesigning basic parts. Standardization improves delivery schedules and service on replacement parts. Protruding conduit box is eliminated. Isolating wound stator from enclosure helps overcome vibrations and noise. **Westinghouse Electric Corp, Box 2278, Pittsburgh, Pa.**

Vault Capacitors . . .

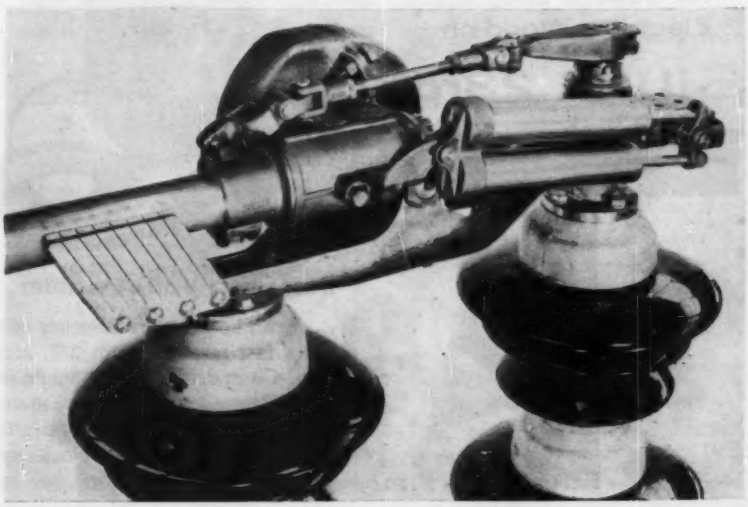
. . . in ratings of 150 or 300 kvar, 4.16 kv, are designed for underground manholes and vaults subject to immersion. It may be used in severely contaminated atmospheres where bushings become coated with conducting material or where clearances would not be adequate with other equipments. Capacitor units and terminal boxes are corrosion resistant. The 2,400-v single phase units are connected for grounded wye use and mounted in a steel rack. **General Electric Co, Schenectady 5, N. Y.**



HV Switch . . .

. . . rated 69 through 161 kv and from 600 to 2,600 amp is designed to remain closed during high momentary current transients. Current flow on main contact of HM50 switch forces blade into the contact. Cross toggle linkage prevents blade from rotating or rising. Blade is locked under solid ledge of contact support. Multiple contact fingers, each with own spring action, provide high pressure contact over wide surface area.
Electrical Engineers Equipment Co, Melrose Park, Ill.

(*More New Equipment on page* 80)



S

Sensational! Line Material Industries will announce a sensational new development to help utility companies improve their operations and their earnings.

R

Revolutionary! This revolutionary new development will be announced in Electrical World on

JUNE 23rd

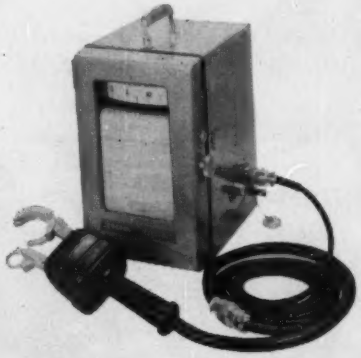
T

345

Condenser Bushings . . .

. . . for power transformers and circuit breakers have standardized over-all length and mounting dimensions, to make them interchangeable. They are available in voltage ratings from 92 through 196 kv.

These Type O bushings have normally ungrounded, fully insulated capacitance tap, brought to terminal on mounting flange, to permit power factor measurement without disconnecting bushing from transformer winding or removing breaker grids. Stud insulation design equalizes dielectric stress.
Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



Recording Volt-Ammeter . . .

. . . with hook-on transformer combines fast response with 2% accuracy. Chart drives include single and double speed synchronous motors rated 120/240 v, 60 cps, and a 60-day, hand-wound spring clock type. Continuous, direct-writing ink system records all peaks and valleys. Voltage ranges include 150/300/750 v ac; current ranges are 15/30/75/150/300/750 amp. The 150-ft chart has 4.5-in. calibrated width. Butyl molded insulation on transformer permits outdoor use on uninsulated lines up to 8,700 v line-to-line. Transformers and leads can be interchanged.
General Electric Co, Schenectady 5, N. Y.

Time Interval Meter . . .

. . . for measuring breaker or relay opening and closing times covers range from 5 microsecs to 1 sec in eight steps. Model KM 1 is accurate within 2% and can be used in field or laboratory. It operates from 110-v line and can be used by untrained personnel. During measured interval, gate permits charging of capacitor. Vacuum tube voltmeter, calibrated in time divisions, measures increase in voltage drop across capacitor.

Presin Co, 12128 W Pico Blvd, Los Angeles, Cal.

Carrier Current Relay . . .

. . . rated 10 w, is completely transistorized. This Type CS-17 transmitter receiver provides a channel for directional comparison relaying or supervisory control function and AM telephone facilities. High power output increase reliability under adverse conditions. Equipment is easily accessible for maintenance and has provisions for measuring important voltages and currents with standard analyzer. It operates from 48 v dc as well as 125 and 250-v supplies.
General Electric Co, Communications Products Dept, Syracuse, N. Y.

Compression Sleeves . . .

. . . for service entrances accommodate No. 10 and No. 8 stranded or No. 8 and No. 6 solid conductors. Available in 16 sizes, they are color-coded and have conductor sizes printed on end tapes. Sleeves

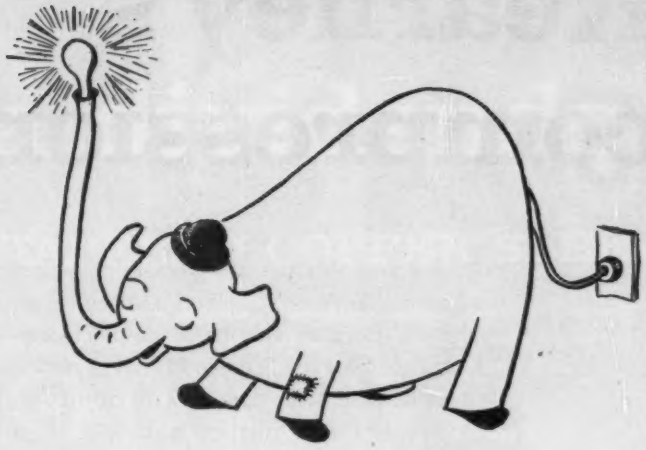
are filled with z.l.n. contact aid to improve conductivity, corrosion resistance, and temperature range. Made in ½- and ⅝-in. diameters, they can be compressed with standard tools.
A. B. Chance, Centralia, Mo.

More New Products

Light-weight, pocket-size Tesco **phase sequence indicator** has insulated body; measures 13/16-in. in diameter and $7\frac{9}{16}$-in. long; weighs less than 3 oz; packed individually in a tubular plastic container.—Eastern Specialty Co, Philadelphia 40, Pa.

Packaged **lighting control** has simplified manual interlocking controls. Controllete features standardized 3 to 6-unit assemblies with Varistat controllers, each with maximum output capacity of 2,500 w. Bulletin 76P.—Ward Leonard Electric Co, Mount Vernon, N. Y.

Clamp type **service head** can be used on either rigid conduit or EMT with no additional fittings. Body and cap are cast Feraloy, clamp is ductile aluminum. Head is available, for ¾ to 1.5-in conduit, in several sizes, all having 5-wire, 5-knockout covers. — Crouse-Hinds Co, Syracuse 1, N. Y.



"Sure he eats a lot
...but we got him dirt cheap"

With a photoelectric lighting control, like almost anything else, first cost alone doesn't decide how good a bargain it is—you also have to keep *upkeep* in mind. Although anyone working in the operating division of a utility knows this, there's a fast shuffle that goes "So what if you *do* have to replace these little dandies every year? They're so inexpensive you can *afford* to." This argument might hold water, if the bargain price *and* upkeep came even close to the cost of a good control. But when there's a steady procession of trucks, repair parts, spare parts, work lists, check lists to check the work lists, mixed up burning hours and burned up working crews—it's not wise to even mention bargain controls (you might get assigned to maintenance).

By trying to build a control that will operate dependably for the *longest* possible time, Fisher-Pierce hopes to have built a truly economical one. Long operating life results from conservative design—which begins with a field-tested and proven circuit. It continues with careful selection of components, of the right kind and quality, without cutting corners.

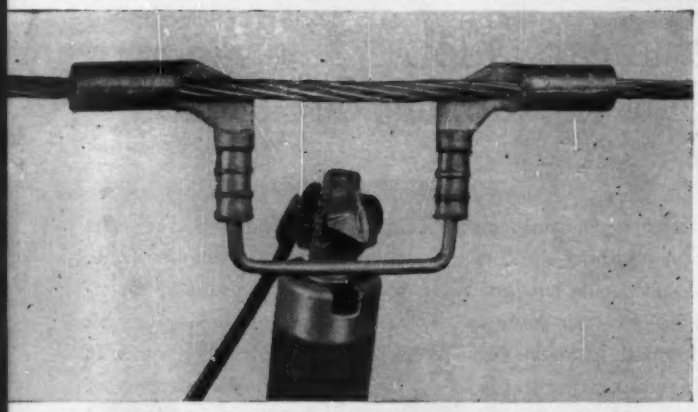
The years of *operating* experience behind the F-P Series 63300C and 64400 controls have proved the soundness of the conservative approach. Neither control has a bargain-basement price—neither one is a "cheap" control. What *is* "cheap" is the number of hours of service life they can provide.

The next time an elephant shows up, you might just ask him how much he eats. The Fisher-Pierce Co., 82 Pearl Street, So. Braintree 85, Mass.

FP
FISHER PIERCE
PHOTOELECTRIC LIGHTING CONTROLS
AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

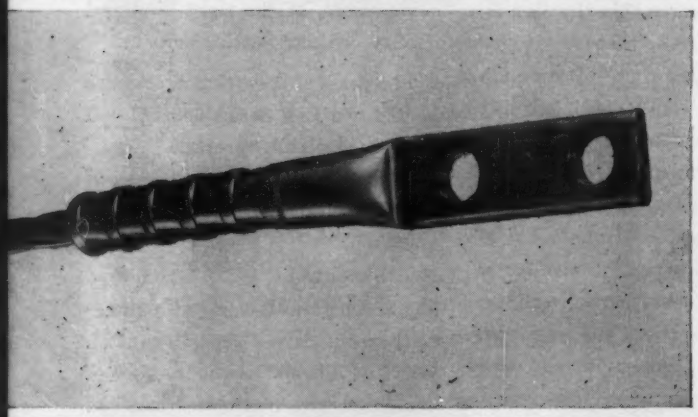
Kearney's compression program

Added versatility and increased application with existing tools—that's what an investment in Kearney Compression can mean for your system. Besides the basic connections—Squeezons, Serv-En Service Entrance Sleeves, Tension Sleeves and others—you receive the advantages of ever widening tool flexibility as Kearney Engineers continue to develop and introduce new Compression Fittings to the field.



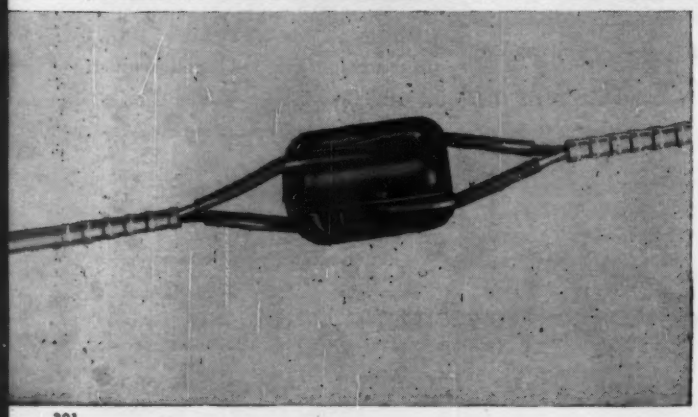
KEARNEY L Squeezon Stirrup

Line side connections are outside the basket—sufficient clearance for either the hydraulic or mechanical tool. The three inch dimension between the line and stirrup makes the unit neat and compact—hot line clamps are readily installed. Unit may be completely covered with line guards.



KEARNEY Compression Terminal

Kearney Compression Terminals provide an efficient method of connecting aluminum conductors to terminal pads. Flaring of strands possible with conventional terminal pads is eliminated. The strands are retained in an aluminum sleeve. Terminals have NEMA 1¾" bolt centers. May also be used as disconnectable jumpers around double dead-ends. The sleeves are filled with Kearnalex Contact Aid and capped and will take conductor sizes from 1/0 to 397.5 MCM 18/1 ACSR.



KEARNEY Insulated Splice

The Insulated Splice was designed primarily for splitting secondaries into shorter sections where additional transformers have been installed and for series street lighting applications. No changes in existing construction are required. Designed for copper, aluminum and ACSR connections, this splice features one piece construction, tension-type sleeves, insulated stainless steel bails and a high strength strain insulator. Splice can be installed with Kearney Hydraulic or Mechanical Tools. ACSR and aluminum sleeves are packed with Kearnalex Contact Aid and plastic capped.

391

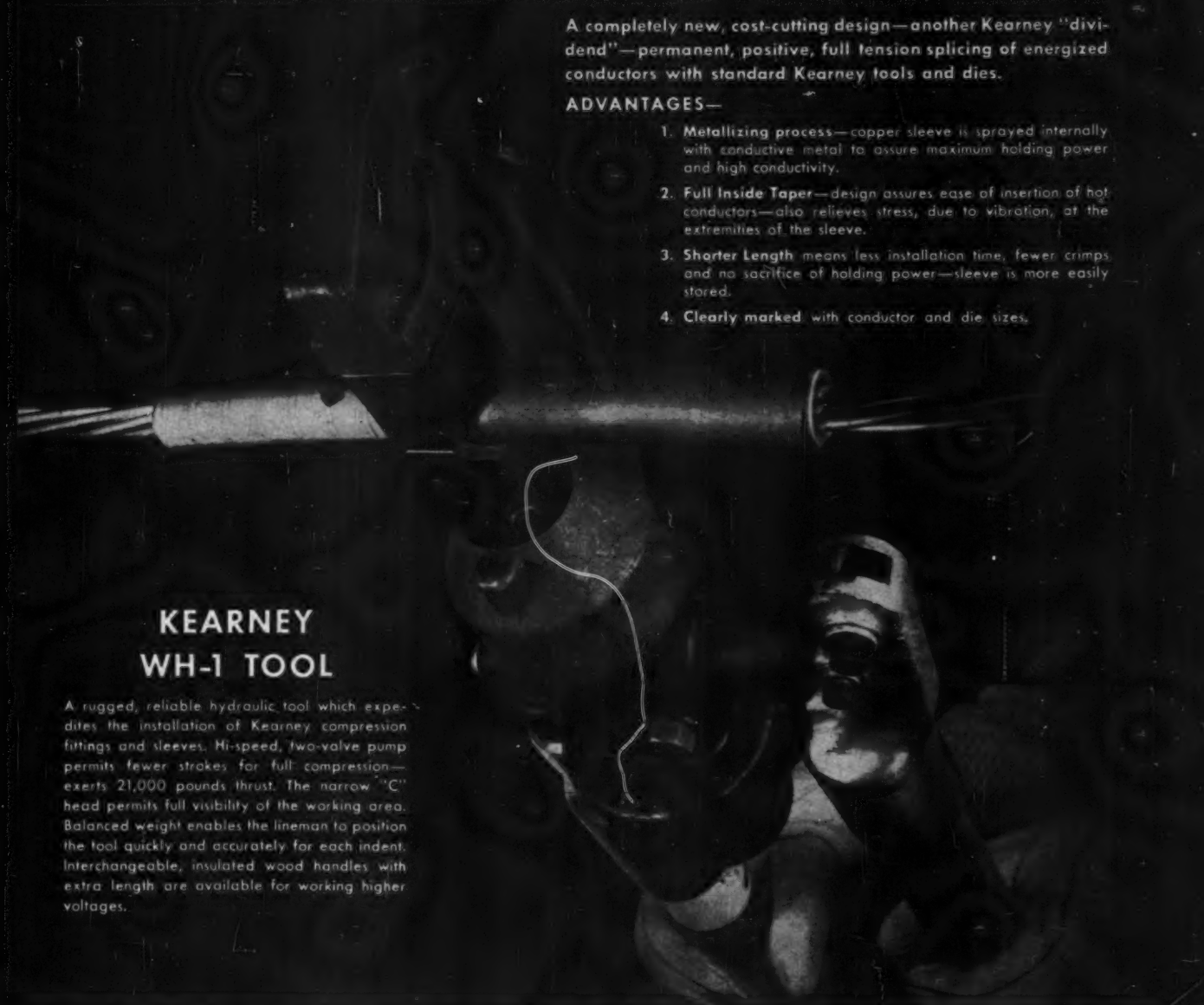
pays extra dividends

KEARNEY INSIDE TAPERED COPPER SLEEVE

A completely new, cost-cutting design—another Kearney "dividend"—permanent, positive, full tension splicing of energized conductors with standard Kearney tools and dies.

ADVANTAGES—

1. **Metallizing process**—copper sleeve is sprayed internally with conductive metal to assure maximum holding power and high conductivity.
2. **Full Inside Taper**—design assures ease of insertion of hot conductors—also relieves stress, due to vibration, at the extremities of the sleeve.
3. **Shorter Length** means less installation time, fewer crimps and no sacrifice of holding power—sleeve is more easily stored.
4. **Clearly marked** with conductor and die sizes.



KEARNEY WH-1 TOOL

A rugged, reliable hydraulic tool which expedites the installation of Kearney compression fittings and sleeves. Hi-speed, two-valve pump permits fewer strokes for full compression—exerts 21,000 pounds thrust. The narrow "C" head permits full visibility of the working area. Balanced weight enables the lineman to position the tool quickly and accurately for each indent. Interchangeable, insulated wood handles with extra length are available for working higher voltages.

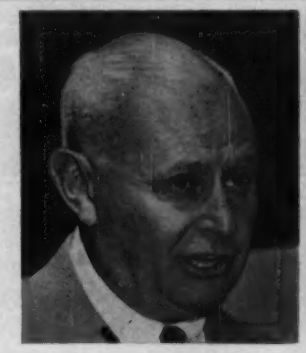
FOR BETTER CONSTRUCTION—SAFER MAINTENANCE

Specify Kearney Products

PLANTS AT: ST. LOUIS • FAYETTEVILLE, ARKANSAS • SHENANDOAH & CLARINDA, IOWA • GUELPH, ONTARIO, CANADA

CEI, Westinghouse Use 'Nuggets' to Combat Recession

Utility 'Reddy Prospector' program will use employees to canvass appliance prospects. Prospectors' get free appliances



LINDSETH

WITTING

'There's gold in them thar customers'

Cleveland Electric Illuminating Co and a major electrical manufacturer got together recently on some double-team blocking to help stop the recession.

Two men—CEI President Elmer Lindseth and Chris J. Witting, vice president, Consumer Products Division of Westinghouse—kicked off a sales promotion program aimed at recessing the recession.

The Illuminating Co will launch a seven-month "Reddy Prospector" program designed to make salesmen of each of its 4,700 employees. Employees will be asked to interest their CEI-customer friends and neighbors in modern living by urging them to purchase electric appliances. For this employees will earn points, or "nuggets", redeemable for free electric appliances.

The program was outlined for some 700 CEI supervisors and specialists at a dinner recently.

Mr. Lindseth stressed the importance of sales thusly:

"We're in for a bad year. Our earnings are going to be off. Our volume is going to be cut. Now what's the answer?

"Cost reduction is, of course, very important (CEI employees cut internal costs $400,000 the first four months of '58.); but cost-cutting is only part of the story."

Increase Sales, Raise Revenues

He pointed out that the company will not be able to reduce taxes, depreciation, or interest rates. "So the alternate, then," he said, "is to raise our revenues, increase our sales. The gold rush may be over as far as California and the Klondike are concerned, but it is just beginning for you and the rest of our employees. We are going to start a prospecting program for gold because there is gold in them thar customers in our territory. It's going to be a big selling push that every employee—everyone of you—can participate in. We're to call it the 'Reddy Prospector' program."

Mr. Witting, who spoke on "The Shape of Tomorrow—Electrically", gave his full support to the program. Quote Witting: "From what I've been able to learn about this Reddy Prospector program, it's just the kind of promotion that this electrical industry needs now.

"I'd like to see utilities around the country pick it up and emulate it. If they do, I'm sure their residential load will rise sharply. Just imagine the support you're going to bring to Cleveland dealers when your army of employees starts prospecting for likely appliance buyers."

Witting also pointed out that the program will mean a boost for low-saturation appliances. "What electric utility employees have to keep uppermost in their minds is revenue and return," he said. "When you think of these things in connection with this promotion and the schedule of rewards, you'll surely consider what you can do to move many of the low saturation appliances—ranges, home heating systems, room air conditioners, and the like."

Vepco Lures Heat Pump Dealers with $100 Subsidy

Virginia Electric & Power Co recently announced a heat pump dealer development plan which pays a dealer $100 for each package heat pump, 2½-tons or more, that is sold between March 15, 1958, and March 14, 1959. The unit must be installed in accordance with the utility's standards prior to Oct. 1, 1959.

This program is aimed at creating enthusiasm among franchised heat pump dealers. It specifically excludes the following sales categories:

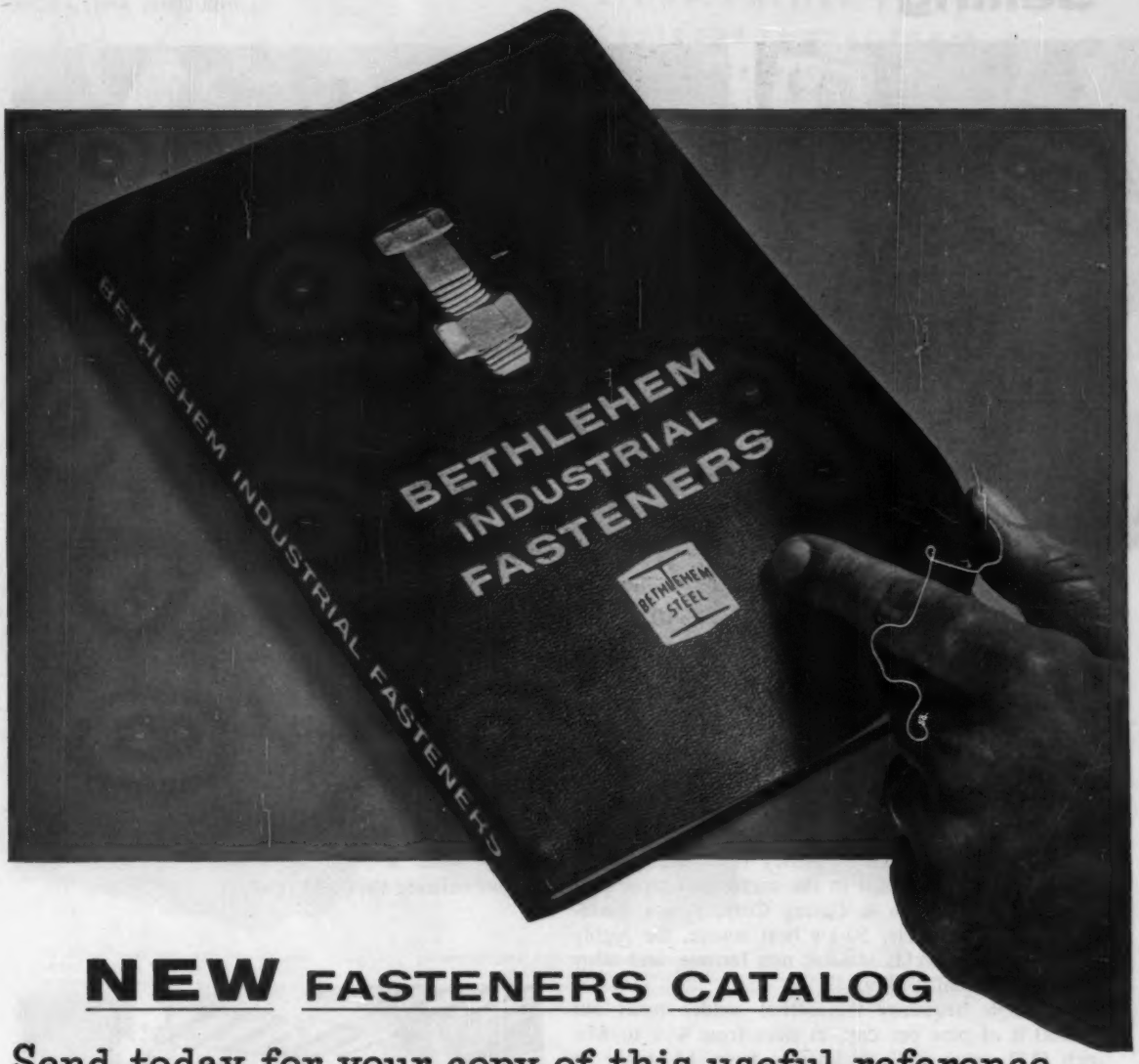
1. Direct sales by distributors or manufacturers.

2. Sales through special or limited dealer franchises for but one or a few installations.

3. Sales for military housing, public housing, or other large scale government applications.

To qualify his heat pump installations, the dealer must notify the company, in writing, twice. First notice is at the time the sales contract is negotiated but prior to actual installation. Second notice is given when each job is completed. After receipt of this notice, Vepco pays the dealer $100.

(*More Selling on page* 86)



NEW FASTENERS CATALOG

Send today for your copy of this useful reference, the most complete edition ever issued!

Bethlehem has just issued "Industrial Fasteners," an illustrated catalog on headed and threaded fasteners. Handsomely bound, this 164-page catalog is attractively printed in two colors; and it is packed with data on just about every type and size of fastener imaginable. List prices, dimensions, weights, and container quantities are also included.

If you have not yet received your copy, use the accompanying coupon. Simply print your name and address, clip the coupon, and mail it direct to us at Bethlehem, Pa.

Publications Department, Room 1038
Bethlehem Steel Company
Bethlehem, Pa.

Gentlemen:
I would like to have a copy of "Industrial Fasteners," your new 164-page catalog (No. 436) on headed and threaded fastener items.

*Name*_____ *Title*_____

*Company*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

Photo Courtesy of New Rochelle Tool Corp

Steel pipe rolls off line . . . . . at rate of 20,000 ft per day as . . .

New Welding Process Boosts Pipe Quality

Stronger and better quality welded steel pipe, with no interior or exterior weld beads, is now being produced with a new high frequency resistance welding process recently installed in the continuous pipe mills of the Southern Pipe & Casing Corp, Azusa, Calif. Using a 450-kilocycle, 50-kw heat source, the highly efficient process welds ferrous, non ferrous, and alloy tubing with equal facility.

The high frequency thermotool welder turns out 20,000 ft of pipe per day, in sizes from 4½ to 8⅝ inch O.D., with wall thicknesses from 14 gauge to $\frac{3}{16}$-inch. Because there are no interior or exterior beads, holiday-free coatings, whether mill or field applied, are assured. Because the high frequency current penetrates only a few thousandths of an inch, only minor metallurgical changes are produced in the metal immediately adjacent to the weld. After normalizing, micro-examination reveals little change between the weld zone and the parent sheet. Southern Pipe recently received the right to use the American Petroleum Institute monogram on pipe produced by this process.

The weld is produced by proximity and skin effect phenomena of the high frequency current on the interfaces of flat strip, formed into a tube or pipe. Formed strip coming from a conventional tube mill reaches the welding area in an open seam condition. Current is brought to the weld area by two sliding contacts, one on each side of the seam, a few inches from the weld point. Because of the longer heating time, "stitching effect" is eliminated.

As soon as the strip edges are brought to welding temperature, pressure rolls force them together to form a forged type weld. After the interior and exterior flash metal has been removed by scarfing, the tube travels under a 10-kilocycle induction heating head for normalizing the weld zone.

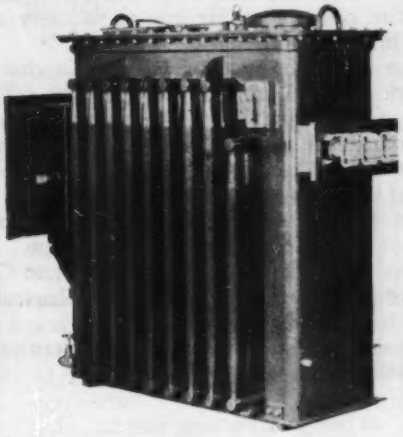
Heater Combines Comfort, Economy

Portable, 4-kw radiant heaters at the Washington Truck Sales in Spokane, Wash., provide adequate heat and light, without the expense of heating the entire building. Telescoping stands are adjustable between 4 and 12 ft.

Six week delivery
Designed to your specs
Incorporates your components
Exceeds all NEMA standards

LO-TEMP*
NETWORK TRANSFORMERS
...ALL THE SAME BUT EACH DIFFERENT

Oil filled with primary switch and protector type throat on one side instead of opposite ends to permit installation in an existing vault.



Askarel filled with usual arrangement of high and low voltage terminations for installation in a limited space.

Oil filled with primary switch and protector type throat on one side with "pancake" type radiators to permit ease of cleaning and maximum cooling.

You pay no premiums, select your own components and get your network transformers designed to your specifications in less time at Standard. The three units illustrated point up the need for transformers DESIGNED for the duty they perform. Each unit has the same basic design and performs the same basic duty in a network system . . . BUT THEY'RE ALL A BIT DIFFERENT. These variations permit these units to be used in existing locations and utilize existing circuits.

There are extra benefits in Standard's LO-TEMP units. They have ample steel and ample copper that give you extra capacity at no extra cost. Extra capacity adds up to longer life and no service interruptions. These are the considerations that mean added revenue to you.

Get the facts on Standard's LO-TEMP Network Transformers from your nearby Standard representative today. He'll show you, in dollars and cents, how you can get premium transformers at off-the-shelf prices.

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Otter Tail Makes Top Management Promotions

A. V. HARTL

W. K. NYE

Key executives who recently received promotions by Otter Tail Power Co are Albert V. Hartl, who was named to the new post of executive vice president; W. K. Nye, who was appointed vice president-electrical; R. O. M. Grutle, who rose to vice president-production; and H. R. Cowles, who advanced to chief engineer.

In addition, Harry C. Johnson was elected controller and treasurer; John M. West, secretary; and Donald V. Eng, assistant secretary.

Prior to his promotion, Hartl had been vice president and treasurer since 1952. A University of North Dakota graduate with experience at the state's Public Service Commission, he joined Otter Tail Power in 1946 as assistant comptroller. He rose to secretary and treasurer in 1949.

Nye is former electrical engineer in charge of the electrical dept. During his 24 years with OTP, he has been meter tester, electrical serviceman, meter dept superintendent, and construction superintendent.

Grutle, general plant superintendent since 1950, joined OTP 22 years ago as results engineer and later advanced to staff engineer. He is an engineering graduate of North Dakota Agricultural College.

Cowles, who earned his EE degree from Case Institute of Technology, has been chief mechanical engineer since he joined the company in 1947. He is a registered professional engineer, mechanical and electrical, in Ohio and Minnesota.

R. O. M. GRUTLE

H. R. COWLES

Louisiana P&L Elects Three Vice Presidents

Louisiana Power & Light Co has announced the recent promotions of three department heads to vice presidential positions in the company. They are C. L. Osterberger, formerly general manager of sales and development; A. E. Elliott, a director and company treasurer; and W. H. Senyard, previously director of personnel.

Osterberger has been serving as general sales manager of the utility since 1937. A graduate of Louisiana State University, he had been acting head of the agricultural engineering dept of LSU before joining LP&L in 1929. He is past president of the Electrical Association of New Orleans.

Elliott, treasurer since 1933, has been with LP&L since 1928, when he joined the company as a clerk. An Ohio State University graduate, he is a former Controller's Club president and past chairman of the financial and accounting section of Southeastern Electric Exchange.

Senyard has been director of personnel since 1929. He joined LP&L in 1926, shortly after graduating from University of Arkansas. He is now vice chairman of Edison Electric Institute's industrial relations committee and is past chairman of SEE's personnel administration section.

C. L. OSTERBERGER

A. E. ELLIOTT

W. H. SENYARD

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Write for Bulletin DH-521A

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AMERICAN CHAIN & CABLE
Bridgeport, Conn. • York, Pa.

OG&E Ups Danner

Ronald F. Danner has been elected vice president-research and development at Oklahoma Gas & Electric, and Clarence Anthony, executive asst-operations.

Danner, manager of engineering and construction since 1948, goes into his new assignment with a solid engineering background. An EE graduate of University of Oklahoma, he has held numerous engineering posts since joining OG&E in 1921.

Burgess Elected VP

Recently elected as vice president and treasurer of Northern States Power Co was A. L. Burgess. He succeeds D. T. Montgomery, retired.

In his new position Burgess becomes principal accounting officer of the utility. His most recent position of assistant treasurer and comptroller has been assumed by A. G. Shogren, former assistant treasurer and assistant comptroller.

Wagner Advances

Detroit Edison Co has advanced Harvey A. Wagner from assistant manager of engineering to manager of system development.

He will now coordinate and appraise engineering, construction, and operating expenditures, and is responsible for advanced planning relating to expansion of plants and other electric power facilities.

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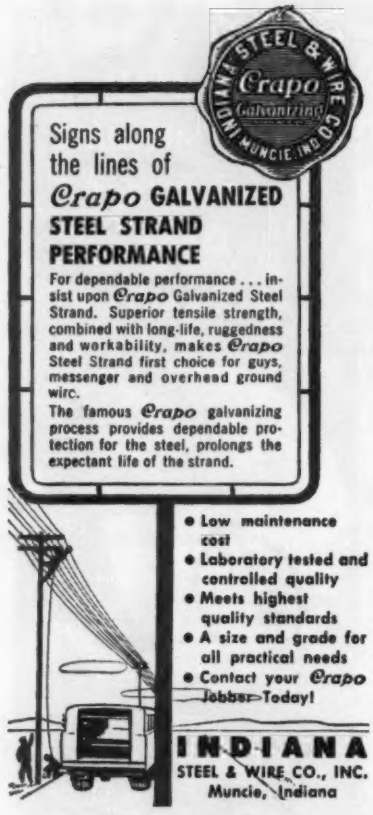
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SURE RATES

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GE Elevates VP Wichman

At General Electric Co, Vice President William C. Wichman has been appointed as general manager of the Hotpoint Co Division. In this position, he succeeds John C. Sharp, who has retired as the division's president and general manager, but remains for several months as a consultant.

Wichman, general manager of the GE Supply Co Division for the past few months, is succeeded in that post by Reginald H. Jones.

W. C. WICHMAN

PERSONAL BRIEFS

In top sales appointments, Kansas City Power & Light Co recently named **Henry M. Turrell** general sales manager, in charge of sales and promotion activities; **Glen S. Young** director of area development; and **G. A. Jennings** head of power and lighting sales. Also promoted were **J. A. Kramer,** to manager of the Kansas district; **G. T. Pettus** to manager of the new customer service center; and **Russell H. Bettis** to manager of credit and collections.

Ernest L. McKenzie becomes an officer of Arkansas Missouri Power Co with his recent promotion to assistant treasurer . . . Consolidated Water Power & Paper Co has named **Gilbert K. Dickerman** to the new post of director of corporate planning and development.

Southwestern Gas & Electric Co has elevated **W. J. Heinrichs** to merchandise sales manager. He's succeeded as Fayetteville Division sales manager by **H. Homer Dalrymple. Hiram F. Brandon** is Arkansas Power & Light Co's new superintendent of the Eastern Division. His former post as Brinkley manager has been assumed by **John P. Graham.**

Charles E. Michel, a former vice president-sales for Union Electric Co, has retired from the utility's board of directors. He will serve as an advisor to the board.

New manager of commercial and industrial sales in Washington Water Power Co's Spokane Division is **Alan V. Carlson.**

I. Arthur Rohrig replaces retiring **Joseph A. Blecki** as materials engineer for Detroit Edison Co's planning and project engineering department . . . At Duquesne Light Co, **William P. Cook** has been named superintendent of operations, eastern district.

At Gulf States Utilities Co, **Lloyd N. Brannan** has been named system supervisor of area development in Beaumont; **Lamoyne Goodwin,** district superintendent at Silsbee; **James H. Derr, Jr,** test supervisor at Roy S. Nelson station; and **George F. Brill,** test supervisor at Riverside station.

New supervisor of transmission lines at the general office of Alabama Power Co is **J. H. Miller, Jr.**

Edward Simmons is new director of sales for Triangle Conduit & Cable Co's Electrical Division. He is responsible for the sale of the firm's electrical products, including power, control, and lighting cables, building wire, and conduit.

First chairman of the new room air conditioner section of National Electrical Manufacturers Assn is **J. B. Ogden,** general manager of Whirlpool Corp's Air Conditioning Division.

At Day-Brite Lighting, Inc, **Ellsworth S. Cabot** has risen to general manager of industrial engineering. **James F. Brennan** succeeds him as manager of Day-Brite Lighting, Inc, of California plant in Santa Clara.

Westinghouse Electric Corp recently advanced **Brian J. Sturman, Jr,** to manager of its manufacturing and repair plant at Compton, Calif . . . **Robert L. Hubbert** is now Pacific Coast regional manager of accounting for the company.

The Delta-Star Electric Division of H. K. Porter Co has named **Glenn R. Smith** as sales manager of electric service works . . . **Allen W. Lishawa** is new sales manager of International Business Machines Corp's Special Engineering Products Division . . . Graybar Electric Co, Inc, recently promoted **Edwin Lex Bacon** to national advertising and sales promotion manager.

The Apparatus Sales Division of General Electric Co has named **William W. Jenkins** as counsel.

John J. Klosin has been given increased responsibility at Thomas & Betts Co with his recent appointment as manager of the Utility Division. He will be in charge of all utility sales and engineering.

T. F. Carter is new works manager of Preformed Line Products Co's West Coast manufacturing plant at Palo Alto, Calif. . . . Thor Power Tool Co has appointed **Peter Rebechini** chief electric tool engineer. He's succeeded as director of the firm's engineering laboratory by **Rex Beach.**

M. H. Cutler was recently made assistant engineering manager of Stone & Webster Engineering Corp, and **Robert M. Jacobs** was promoted to chief structural engineer.

Kellogg International Corp, a subsidiary of M. W. Kellogg Co, has elected **E. F. Liebrecht** as president. He continues as vice president of the parent firm . . . **Harry D. Weller, Jr,** has been appointed vice president of White Motor Co's Eastern region.

OBITUARY

Cecil Lynch, 74, a director of Arkansas Power & Light Co and executive vice president until his retirement in 1948, died recently as a result of complications received in a highway accident on May 19 near Little Rock.

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When busy engineers and executives in the dynamic electric power industry get around to naming the one magazine they find most useful in their work, it's ELECTRICAL WORLD, by a margin of 4 to 1. Year after year, survey after survey, WORLD earns *at least* four times as many votes as any other magazine in the field.

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Relaying Is Topic at Georgia Tech

TVA speaker offers technique for discriminating between load and fault; GE speaker one for cold-load pickup

Relaying for future distribution systems was scrutinized by two engineers at the Georgia Tech Protective Relaying Conference in Atlanta, Ga. They foresee the need for relaying techniques to handle line burndown, coordination, reclosing, cold-load pickup, and backup.

M. Stephens Merritt, Tennessee Valley Authority, suggested the use of load power factor compared with impedance angle of the line to discriminate between load and faults. Use of such a relay could minimize cold-load pickup problems and improve coordination. But the phase-angle discriminating distance relay would require that trip-actuating elements of sectionalizing devices be modified for definite time tripping rather than inverse characteristics.

Another suggestion by Merritt was the development of a relay that would recognize high-resistance ground faults by the harmonics produced. The relay would have to differentiate between these harmonics and triple harmonics from normal operation.

Triple harmonics produced by overexcited transformers sometimes cause ground relay operations when combined with normal unbalance, said Merritt. To eliminate this problem and possibly tripping from unbalanced loads, he suggested development of a relay to operate on 60 cps with restraint from triple harmonics.

The most suitable phase-relay characteristic for cold-load pickup is the extremely inverse curve, said A. J. McConnell, General Electric Co. But this relay will not take care of the entire problem because a setting may be reached, resulting from load growth, that will not protect for all faults. In this event, fuses and reclosers should be moved closer to the substation, or automatic sectionalizing be applied.

Sees Peak and Decline

McConnell predicted that the cold-load problem may reach a peak and then decline. This is due to the relatively favorable aspects of growing heat-pump and air-conditioning loads which will require larger circuits and have relays to prevent operation during low-voltage conditions.

The present trend away from breakers towards reclosers may be reversed, said McConnell, if high-sensitivity ground-fault protection becomes more widespread, but it is doubtful whether reclosers could be obtained with the desired ground-fault sensitivity.

An inexpensive scheme for checking 3-phase line-side potential of breakers has been developed by Georgia Power Co, utilizing mainly vital parts already provided, said R. J. Cooper. In the scheme, the bushing-type potential device on each 115-kv line breaker, which is normally used for checking synchronism, operates one phase of the voltage checking relay. Two extra bushing potential-device high-voltage cables with fittings connect the hot bushing taps of the other phases through coils of small telephone relays (2,150-ohm) to ground. Installed cost of the additional equipment is about $500.

TVA depends almost entirely on secondary tests to check connections of protective relays, said J. L. Thompson. Although these do not have the certainty of a series of staged tests under possible switching setups, TVA has found that a high degree of accuracy is obtained by making carefully secondary instrument readings, tripping tests, etc. Exact procedures for testing practically all relays are detailed in a manual test engineers are required to follow.

A new portable test set reduces testing time on relays by 50% for Georgia Power Co, said J. C. Causey. The set operates from 115-v single phase and consists of a variable voltage, test current, and timer. Only connections are for the power source and a 4-wire cable for the current and timing circuits. The set is similar to a tube tester with switches pre-set for a particular relay function and a main switch to initiate each test.

Mutual coupling should be considered in designing relaying for parallel lines of different voltages, said William G. Rankin Jr, Virginia Electric & Power Co. Mutual coupling can cause tertiary reversal in autotransformers and neutral reversal in wye-delta transformers. But when parallel lines are of the same voltage and bussed at both ends, mutual coupling can generally be neglected, provided the ground relays are not set very sensitively.

The family of K-Dar relays can be tested and calibrated by the same methods and facilities, said H. J. Calhoun and W. L. Himman, West-

(*Continued on page* 94)

J. C. CAUSEY, Georgia Power, explains relay test set to D. B. Brant, General Electric; M. S. Merritt, Tennessee Valley Authority; H. J. Calhoun, Westinghouse

NEW LITERATURE

• **POLE TREATMENTS:** A 14-p publication entitled, "1958 Progress Report—Pentachlorophenol Pole Treatments" contains numerous illustrations and considerable data after actual years of treated pole exposure by electric utilities. J. D. Barnes, engineer of wood preservation, supervised the tests and computations. Page & Hill, Inc, Minneapolis 3, Minn, will provide a copy of the publication when requested on your company's letterhead.

• **INDUCTION MOTORS:** A 16-p bulletin, No. 1950, presents information on full line of motors in ratings from 150 to 1250-hp. Another, 8 pp, No. 1900, features the Syncro-Spede synchronous induction motor. The Louis Allis Co, 427 E. Stewart St, Milwaukee 1, Wisc.

• **DIGITAL COMPUTER:** Bulletin AB-116-R-018 gives specifications, accessory equipment and applications of Bendix G-15 digital computor. Bendix Aviation Corp, 5630 Arbor Vitae St, Los Angeles 45, Calif.

• **STRIP CONDUCTORS:** Anodized aluminum strip conductors are detailed in this 12-p booklet. Contains technical information on the advantages, applications, heat transfer properties, windings and joining of conductors. No. EE-2-10-158. Reynolds Metals Co, 2500 S. Third St, Louisville, Ky.

•**PROTECTIVE COATINGS:** This 36-p manual (Form 257) covers methods of surface preparation, use of primers, and finish coatings, availability of special custom coatings, and other material on protective coatings. Rust-Oleum Corp. 2799 Oakton St, Evanston, Ill.

• **ALLOY CONDUCTORS:** The properties of aluminum alloy wires and cables for overhead power lines are presented in an 18-p brochure. Reynolds Metals Co, General Sales Office, Louisville 1, Ky.

• **POLES:** Information of an engineering and general nature to aid the buyer. Brown Wood Preserving Co, 409 Commonwealth Bldg, Louisville 2, Ky.

• **POWER RECTIFIERS:** A 32-p guide to metallic power rectifiers utilizing germanium, silicon and selenium semiconductors. Sel-Rex Corp, Nutley, N. J.

• **RELAY AND CONTROL SWITCHBOARDS:** Specifications and design features of relay and control switch boards are emphasized in a 20-p catalog. Northeastern Engineering, Inc, 25 S. Bedford St, Manchester, N. H.

• **ALUMINUM CONDUCTORS:** A 12-p brochure stresses economic advantages of the aluminum conductor for farm wiring. Bulletin EC-713-12-57. Kaiser Aluminum & Chemical Sales, 919 N. Michigan Ave, Chicago 11, Ill.

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125	WEST	2300	250
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Relaying Is Topic at Georgia Tech (*Continued from page* 92)

inghouse Electric Corp. Complete laboratory tests are made with the usual equipment for testing single-phase impedance relays along with adjustable 3-phase voltage and single-phase current supplies. For field use a portable unit will soon be available, which will provide a 3-phase voltage from a single-phase source.

Sharing computer programs reduces programming costs, but can be a source of errors, said W. J. McKune, Georgia Institute of Technology. The receiver of a program may not know exactly how much attention went into removing possible sources of errors in writing the program and how to use the program to minimize such errors. To obtain the knowledge the receiver could spend as much time as required for writing this program.

High-speed relaying of transformer banks should be accomplished by applying differential relays along with sudden-pressure relays, where applicable, said R. L. Sharp and W. E. Rich, Westinghouse. To prevent false operations due to magnetizing-inrush currents, harmonic-restraint units should be used.

Readers Forum

How To Bind Perforated Pages

To the Editor:

Why don't you tell the few who complain about binding the new wonderful "tear out" pages to use gummed reinforcements. Three methods are illustrated on the attached page. Any of the three permits ready binding in a loose-leaf notebook. A fourth way is to fold over a strip of gummed linen tape and punch.

If they don't want to tear the pages out they can reinforce the perforations with cellophane tape and have no trouble.

Walter Morton
Chief Electrical Engineer
Pennsylvania Power & Light Co.
Allentown, Pa.

Editors note: The methods used by Mr. Morton consist of reinforcements either extending beyond the perforations or within the perforations to make pages suitable for placing in loose leaf notebook.

Million—Not Billion

To the Editor:

Your very interesting May 26th "Management Newsletter" on King Coal caught my attention, focussed as it should be on prices and costs of fuels to discern the welfare of natural gas, the youngest and lustiest (so far) members of the family.

May I venture to suggest that the price chart on page 102 is based on cents per million btu, rather than billion, if no one else has been so rude as to bring this up?

Franklin P. Hall
Federal Power Commission
Washington, 25, D. C.

Many thanks, Reader Hall, for catching that glaring error. It should, as you say, have been million.

"Now It Is Easy"

To the Editor:

This letter should have been written to you some time ago. I want to congratulate you and tell you, as a subscriber, how much I appreciate the innovation of the perforated pages. It is one of the most practical things that has been done by any magazine I read.

We clip articles from the ELECTRICAL WORLD frequently, and put them in our files. Prior to the perforated pages, it was a mess. Now it is easy.

Thanks for making ELECTRICAL WORLD more convenient to use.

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Advertising Index

Allis-Chalmers Mfg. Co. ..... 4th Cover
American Chain & Cable Co., Inc. Wright Hoist Div. 89

Bethlehem Steel Co. 85
Bodendieck Tool Company 91

Chevrolet Div., General Motors Corp. 16
Circle Wire & Cable Corp. 31

DeLaval Steam Turbine Co. 33
Directory of Engineers 93
Dowell Incorporated 14

Engineers, Directory of 93

Fisher-Pierce Co. 81
Fluor Corp., Ltd. 67

General Electric Co. 62, 63
Apparatus Dept. ..... 2nd Cover, 59, 60, 61
Graybar Electric Co., Inc. 7

I-T-E Circuit Breaker Co., Switchgear Div. 6
Indiana Steel & Wire Co., Inc. 90

Kearney Corp., James R. 82, 83
Kellogg Company, M. W. 38
Kirk Dial & Crystal Co. 89

Lapp Insulator Co., Inc. 32
Line Material Industries 23, 24, 25, 80, 90

Moloney Electric Co. 10, 11
Motorola Communications & Electronics, Inc. 30

Paranite Wire & Cable Div., Essex Wire Corp. 65
Pennsylvania Transformer Div., McGraw-Edison Co. 15
Premax Products Div., Chisholm-Ryder Co., Inc. 91

RT&E Corp. 4
Roebling's Sons Corp., John A. 26, 27
Rolatape, Inc. 89
Rome Cable Corp. 35, 70

S&C Electric Co. 8, 9
Sangamo Electric Co. 17
Searchlight Section 93
Simplex Wire & Cable Co. ..... 3rd Cover
Southern States Equipment Corp. 66
Standard Transformer Co. 87

United States Steel Corp., American Steel & Wire Div. 12, 13
Utility Tool & Body Co. 91

Victor Insulators Div. I-T-E Circuit Breaker Co. 18

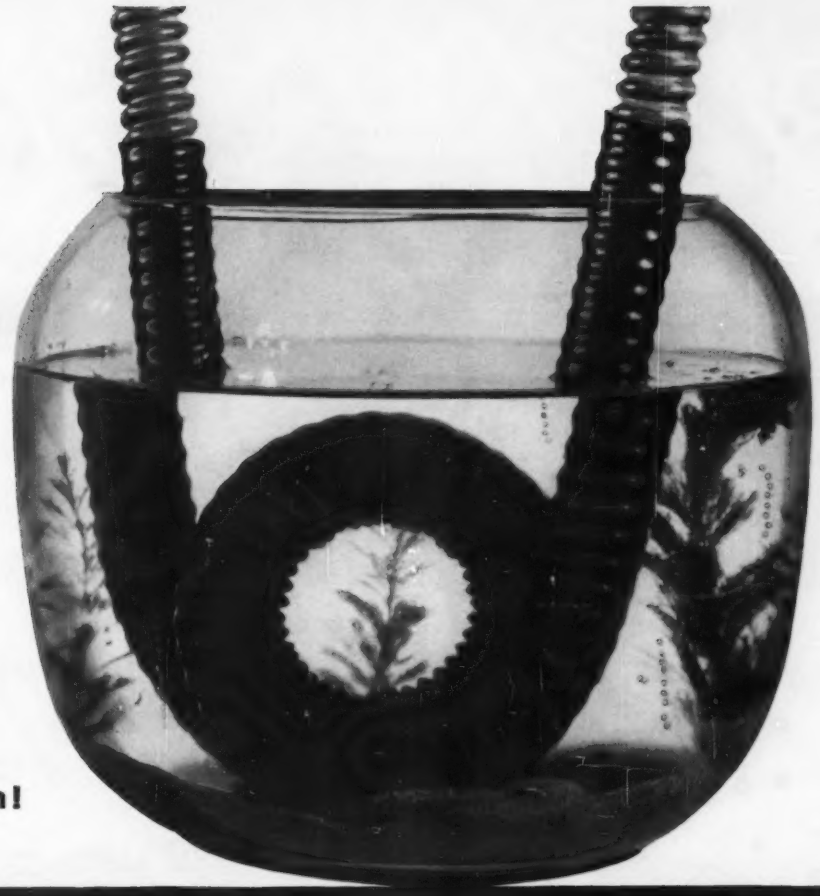
Wagner Electric Corp. 36, 37
Westinghouse Electric Corp. 28, 29, 34, 68, 69, 75, 76, 77, 78
Wright Hoist Div., American Chain & Cable Co., Inc. 89

PROFESSIONAL SERVICES 93

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 93

EQUIPMENT (Used or Surplus New) For Sale 93



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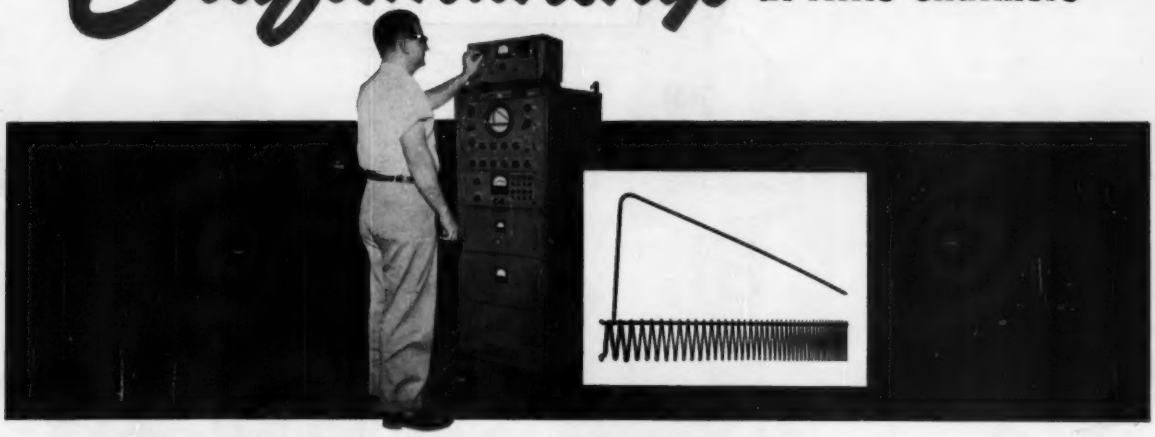

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